The Electrical World.

VOL. XXVI. NEW YORK, NOVEMBER 30, 1895. No. 22.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. *Cable Address: "Electrical," New York*

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

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THE ELECTRICAL WORLD,

253 Broadway, New York.

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ELECTROPLATING SHIPS.

In another column we give an account of a process for electroplating the hulls of ships and other vessels, with illustrations showing its practical application to a vessel now having a layer of copper deposited on its hull surface. The protection of iron vessels from sea growths, and from corrosion in harbors and elsewhere where water is contaminated, is a question of much importance, and the result of the present plan will be watched with great interest. Should it prove successful, men-of-war will offer a wide field for its application, for the most serious problem encountered by naval authorities is the serious deterioration of the speed of war vessels cruising in parts where docking facilities are not available. To obviate this difficulty, the specifications of some of our recent naval vessels provide for a wood sheathing for the hull, this in turn to be covered with copper sheathing. The Japanese have attempted to meet the same difficulty by lacquering the hulls of some of their smaller vessels, but the success of this method is not yet established. For the present method to be successful it will have to be shown that marine growths will not adhere to the copper. The covering of wooden bottoms is not a pure copper, but a metal which foliates, and thus tends to get rid of growths that adhere tenaciously to iron.

THE STORAGE BATTERY DISCUSSION.

The first trial by the American Institute of Electrical Engineers of the feature of topical discussion was an unqualified success, and it will, most probably, regularly figure hereafter on the yearly programme. It would be well, however, to hereafter announce the topic as much in advance as practicable, and if selected at the annual convention it would not be too far ahead, even for discussion at a Winter month regular meeting. The several communications read at the Institute meeting on last Wednesday, and the discussions which followed—all of which we print in full abstract elsewhere in this issue—undoubtedly form the best contribution yet made in this country to the practical side of the subject of storage batteries. The papers of Prof. Crocker and Mr. Childs resume in detail the various uses to which they are applicable, the former adding also the disadvantages, and the latter giving much information on points of practical interest. Mr. Hering's remarks bring out the advantages of the Planté type of cell, and refer more particularly to traction batteries, in regard to which he discusses the important question as to the relation which should exist between the life of a cell, its cost and weight, in order to attain the most economical service. Those who complain that the storage battery has been too much coddled, and that reference to any of its faults has been considered in the light of *lèse majesté*, will find no reason to complain of the treatment accorded it by Mr. Perry, who argues that the gas engine is more economical for many purposes for which the storage battery has been claimed to be exclusively applicable. It is undoubtedly true that the gas engine has been sadly neglected in this country, and that it has a most promising future everywhere. The fact remains, however, that in Germany, where the gas engine has received widest adoption and its advantages are most clearly recognized—and where, moreover, the question of central-station auxiliaries has been most carefully studied—the storage battery has not been appreciably affected by its competition. The favorable testimony borne by Mr. Edgar as to the advantages of storage batteries in central-station work is particularly effective on account of being based upon actual experience. While the results that have been obtained in Europe should cause no doubt to be entertained as to the economy that may be obtained from their use in this connection, yet

the lack of experience under the conditions of American practice has discouraged interest in the subject. With the satisfactory results gained at Germantown, Merrill, Wis., and Boston, details of which are now accessible, central and power station managers are brought face to face with the situation, and can no longer afford to delay investigation as to how it affects their interests. In the discussion we note that in one place the storage battery was spoken of as having an ampere-efficiency of 96.1 per cent., and a watt-efficiency of 84 per cent. The absurdity of speaking of ampere-efficiency is so generally recognized that it is surprising to find the term employed in a discussion before the American Institute of Electrical Engineers. While perhaps all of those at the meeting know that the term carries no real significance whatever, if used, however, in presenting the subject of the storage battery to others of less technical knowledge, the result will merely be to excite suspicion with respect to other statements. For it is not difficult to conceive that if an intended purchaser, not knowing the distinction, is told that a battery has an ampere-efficiency of 96 per cent. and a watt-efficiency of 84 per cent., he will not be favorably impressed by the double statement, and may be inclined to believe that there are perhaps still other efficiencies on the descending scale of which he is not told. The only efficiency that should be used is the one which denotes the ratio between the energy taken out of a battery and that put in—the watt-efficiency—for that is the only practical, as well as the only true, efficiency.

MANUFACTURERS AS ELECTRICAL ENGINEERS.

A very considerable amount of our space in this issue is given up to the subject of the storage battery, thus in a sense typifying the recent lively reawakening of interest in a branch of the electrical industry that has too long lain dormant in this country. The manner in which, with all our boasted industrial enterprise, we have lagged behind in this and in several other important branches of electrical application, is somewhat singular. In central-station incandescent lighting, for example, though always immeasurably ahead in the number of plants and in capacity, it is but a few years since that the crudest central-station practice was the rule here, and the great advance made since 1891 is largely due to the adoption of European methods rather than to efforts of our own. Still a more striking example is afforded by the course of development of polyphase working. Though the fundamental inventions connected with the rotary field are of American origin, and the first attempts toward their commercial application were made in this country, yet their development to an engineering and commercial basis may be said to have been almost exclusively the work of European enterprise. But by far the most notable case is that furnished by the history of the storage battery in the United States. Notwithstanding the immense amount of money that has been lavished upon it, the industry, until quite recently, has remained in a state of most "innocuous desuetude." There must be reasons for such exceptional departures from the spirit of American enterprise; and, in fact, several causes may be assigned, aside from the evident ones of patent litigation and stock-jobbing. One of these appears to lie in our tendency to concentrate energy on single objects at a time until they are brought to a comparatively complete stage of development, instead of attempting a uniform advance in a given field of industry. Another deterrent influence, and perhaps the greatest of all, has been that due to the practice of manufacturing electrical companies in monopolizing the functions of the independent electrical engineer. That evil results have come from this practice does not imply that manufacturing companies have not had in their employ capable electrical engineers; on the contrary, their service has offered in general by far the most lucrative prizes, and consequently has attracted the very best grade of ability. The objectionable feature has been the subordination of engineering proper to considerations of commercial and manufacturing exigencies, thus unfavorably affecting both maker and user. The duty of the manufacturer's engineer has not been the production of the best possible engineering designs for given cases, but designs that would most probably enable his company to secure a contract, and the complications thus introduced would all seem to have an unsatisfactory tendency. Owing to the competition the governing factor is cheapness, both in installation and machinery; the latter implies standard types of apparatus, which in turn tends to discourage the timely introduction of the latest advances in technical knowledge. It is to the practice of "standardizing" electrical machinery that crude forms of central-station apparatus continued to be installed several years in this country after it had been discarded abroad and similar instances might be noted. On the other hand, the most creditable of recent electrical engineering work, particularly in connection with electric railways, has resulted from calling on the services of the independent expert or engineer. The functions of the manufacturer and of the engineer are, to a great extent, antagonistic, for, as remarked before, the former is governed entirely by commercial considerations, his object being the sale of his product, regardless of whether it is the best for a given case—the manner of its installation also being controlled by ulterior considerations. The exigencies of the stock market also sometimes introduce further complications, usually through the undertaking of showy but impracticable schemes, affecting, in this case, the industry as a whole rather than individuals. It is the verdict of many competent to judge that Europe is vastly ahead of America from an electrical engineering point of view, and this undoubtedly follows from the fact that there all large electrical plants are designed, and their construction supervised, by electrical engineers employed for the purpose by the purchaser, and having no more connection with commercial interests than civil engineers in this country have in their professional work. We have referred to this subject before in these columns, but in view of the promised revival of the storage battery interest it is well that attention be again directed to it. It is stated that no less than 80 per cent. of the central stations of Germany have storage-battery auxiliaries, almost all of which were probably specified by engineers in the employ of the purchaser. It would therefore seem that storage-battery manufacturing companies in the United States would have nothing to lose by encouraging a similar practice here, particularly as the recommendation of an independent engineer in favor of such an addition to a plant would have immensely more weight than the solicitations of a commercially interested engineer, however highly his professional ability might be regarded.

Experimental Methods.

With Hertz, says Dr. A. G. Webster, in a review of his work, everything was deliberately planned. After proving the velocity of propagation to be finite, knowing that the waves should be capable of reflection and refraction, he makes them reflect and refract. Knowing that oscillatory currents should not penetrate into the interior of conductors, he demonstrates that they do not. Having calculated what mechanical forces they should exercise, he straightway observes them. These researches are pronounced to be a notable example of how experimental work should be prosecuted, and convey a lesson that should be taken to heart by the student. The proper order of procedure may be stated: "Think, calculate, plan, experiment, think,—and first, last, and all the time, *think*." The method often pursued is: "Wonder, guess, putter, guess again, theorize, and above all, avoid calculation."

Electric Railways.

The London *Electrician* considers that by changing from horse to electric traction in a reasonably careful and honest way net earnings per mile will increase at a greater rate than capital expenditure per mile.

November Meeting of the American Institute of Electrical Engineers.

The regular monthly meeting of the American Institute of Electrical Engineers, held on Nov. 20, was devoted to a consideration of the topic "Storage Battery Applications." Communications submitted by A. E. Childs and C. L. Edgar, of Boston; F. B. Crocker, and N. W. Perry, of New York, and Carl Hering, of Philadelphia, formed the basis of discussion, which was participated in by Townsend Wolcott, H. Ward Leonard, E. T. Birdsall, J. B. Entz, J. Appleton, C. Blizard, J. W. Lieb, Jr., F. Reckenzaun and others. All of the papers in abstract, and the main points of the discussion, will be found elsewhere in this issue.

This was the first experience of the Institute in the way of topical discussions, and the result at the New York meeting was very gratifying, both from the interest manifested in the proceedings and the attendance, which numbered 115. The same evening meetings were held in Chicago, and. for the first time, in San Francisco.

At the regular council meeting, the same day, the following associate members were transferred to full membership:

Arthur Hartwell, Julius Martin, Joel W. Stearns, Jr., Maurice Oudin, Louis K. Comstock, Edward D. Brown, Fred A. La Roche, J. J. O'Connell, Frederick William Darlington and Frederick Valdemar Henshaw.

The Niagara Plant.

The Niagara Falls Power Company has invited proposals for the extension of its wheel-pit, and announced that the next installation of power will probably be three more turbines, and as many dynamos. The wheel-pit, when completed in accordance with the present plan, will have room for seven more turbines, and the extension of the power house to a corresponding size will afford room for seven more dynamos, making 10 in all, or a total power from these 10 turbines of 50,000 hp, which is one half of the total capacity of the tunnel. The announcement is one of the most important made by the Power Company since it began operations, as it indicates that its project is a success in every way, and that there is a demand for enough power to warrant the extension of the plant as above stated.

The Electric Lighting Stations of Paris.

At the November meeting of the Societe Internationale des Electricite, M. Jules Laffargue gave an account of the various lighting stations in Paris. The burning of the Opera Comique, in 1887, first brought the subject of incandescent lighting actively to the front, and concessions were granted in 1889, the Continental Edison Company being the first to enter the field. This company has now three stations with a capacity of 3080 kw. The Societe d'Eclairage et de Force par L'Electricite has seven stations with a total capacity of 2685 kw. The Societe du Secteur de Clechy distributes 2470 kw. The Cie Parisienne d'Air Comprime, which has stations at St. Fargo and Boulevard Richard Lenor, distributes 2200 kw, and will presently have another station on Quai Jemmapes, with a capacity of 2400 kw. The Societe des Secteur des Champs Elysees at present distributes 1200 kw by alternating currents at 3000 volts, and is about to add a new alternator of 400-kw capacity. The Societe de la Rive Gauche is now installing outside the walls of Paris, at Issy, on the banks of the Seine, a station of 4000 kw, comprising ten Ganz alternators of 400 kw. and 3000 volts. The municipal system has a capacity of 570 kw—240 in continuous currents, and 330 in alternating currents. At the end of the present year the total capacity of central stations of Paris will be 19,100 kw, supplying 454,560 ten-cp incandescent lamps, and 154 motors aggregating 331 kw. The maximum load during the month of October was 6778 kw, at about 6 o'clock in the evening. The output has grown from 2,284,485 kw-hours in 1890 to 7,883,434 kw-hours in 1894. M. Laffargue stated that as a result of an examination, he found that the aggregate capacity of the isolated lighting plants of Paris was 25,760 hp, of which 23,000 are generated by steam engines, 2260 by gas engines and 500 by compressed air machines.

Faraday, Hertz and Maxwell.

Dr. A. G. Webster advises the student to place Hertz's "Electric Waves" on his shelves, with its first or experimental side next to Faraday's "Experimental Researches," and with its second, or mathematical part, next to Maxwell's "Treatise," "for on these three hang all the law and the prophets of electricity."

Copper vs. Alloy Fuses.

In the discussion on Prof. Stine's Institute paper on "The Rating and Behavior of Fuse Wires," Mr. A. E. Kennelly remarked that the question of copper versus alloy is a very interesting one, but simply bears out the importance of defining what a fuse is intended to do, and the limiting range of overload at which it is intended to melt. In some cases when a fuse is inserted to protect a circuit of given normal maximum current strength, the fuse should not melt unless three times that current strength passes through it. In other cases the fuse should melt when the current strength reaches 25 per cent. above the normal. The fuses which will meet these two distinct requirements are necessarily different.

Lead alloy fuses can be made which will melt at, or even below, the temperature of 100° C. Consequently, under definite conditions, such fuses may readily be made sensitive in regard to action at excess of current, for their normal working temperatures will be but little in excess of the temperature of the air.

Copper wire fuses, on the other hand, melt at say 1050° C., which is a comparatively high temperature. Even granting the existence of a larger temperature coefficient of resistivity, the wire will have to be maintained at a comparatively high temperature, by the normal current strength, if it is required to melt at a small overload. In point of fact, the temperature coefficient of copper does not seem to differ greatly near red heat from its value at the boiling point of water, and in some cases it would be necessary to keep the wire at 500° C., or about red heat under working currents in order to effect fusion at a comparatively small excess of current. When, however, a large range of current excess can be permitted, the advantage of copper are undeniable.

The Slide Rule and How to Use It.

Foreign engineers have often expressed their surprise at the fact that the progressive Americans seem to use the slide rule so little; among foreign engineers it would probably be quite rare to find one at work without a slide rule in his pocket. This instrument is especially useful to electrical engineers, as most of the calculations which he has to make are specially well suited for being made with it. We recommend those who are not yet familiar with the valuable device to an illustrated article by Mr. Snyder in *Engineering News*, Nov. 21, describing how to use it. While there are several different forms in the market, our experience, extending over many years, has been that there is none which is so convenient for the pocket as the ordinary straight form about 10 inches long. There is a smaller one made 8 inches long, but it is not generally kept in stock at the stores.

The Advantage of Being an American.

American electrical engineers may be glad that in addition to their numerous troubles they do not have to tussle with such names as the following: Gödöllö, Puszta-Szent-Mihaly, Csömör, Kerepes, Kis-Szent-Miklos, Pest-Pilis-Solt-K. Kun, Vácz-Hartyán, Kolozsvár, Nagyvarad-Kolozsvár-Brassó, Kolozsmonoster, Szász-Fenes, Szász-Lóna, Gyalubis, Hideg-Szamos, Miskoloz, Rákos-Palota, Uj-Pester, Reschitza, Krassó-Szörény—all of which are places in Europe where electric light and power stations have recently been installed. It is interesting to notice that no mention of the telephone is made in the paper from which we have taken these names, and one cannot help wondering whether it could be used in that country, and if so, how long it would last.

Gas vs. Electricity.

A Parisian writer in stating that it is recognized that gas is maintaining a successful fight with electricity, adds "this remarkable means of illumination (electricity), however, should by no means be allowed to drop entirely (!) even if it is no longer the exclusive source of lighting, but may be combined with advantage by means of its dynamic peculiarities (*sic*) with illumination by gas."

The Three T's.

Col. N. M. Booth, of Evansville, Ind., an old-time telegraph and telephone pioneer, is preparing for the press a book which will have for a title, "Gleanings from the Telegraph, Telephone and Typewriter," and desires to obtain from those who have been connected with any of the above "three T's" their photograph and any personal or other items they may deem of interest.

Water Rheostats.

In a recent article in our columns the convenience of water rheostats for many purposes was pointed out, and several easily constructed forms described. The London *Electrician*, in its current issue, illustrates and describes several types of a more elaborate construction, which we illustrate herewith.

Fig. 2 shows a multiple-tube form of water rheostat designed

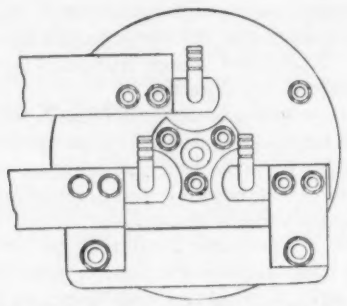
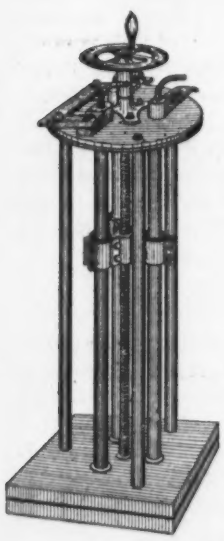


Fig. 1.—Top Connections of Water-Tube Rheostat.

by Major Cardew and Mr. Rennie, and built by Mr. Crompton for use in connection with the large number of Kelvin balances at the Board of Trade Standardizing Laboratory. The dimensions over all of the apparatus are 3 feet 6 inches high by 15 inches × 15 inches, and its range extends from 60 to 5000 amperes. It consists of three resistance tubes, 39⅜ inches long, 1⅜ inches in diameter, and not quite .02 inch thick. Two of these tubes are of manganin (0.004 ohms) and one is of copper. Through each current-carrying tube water is passed from bottom to top, carrying away the heat generated by the current, the density of which sometimes attains 30,000 amperes per square inch. These three tubes, as will be seen by the sketch, are arranged triangularly around the centre of the base. The three outer tubes are supports for the top plate, and do not carry current. The current-carrying tubes are connected across by a traveling brush, adjustable by means of a screw and wheel.

Fig. 1 shows a plan of the top connections of the apparatus, as arranged at the Board of Trade Laboratory, for regulating the flow of current through the Kelvin balance circuit, the water-tube resistance being placed in series with the circuit containing the balances. The manganin tubes are placed in parallel with each other, and in series with the copper tube.

Mr. Crompton is also making a number of *standard* water tube manganin resistances, one of which is shown by Fig. 3. Its resistance is a thousandth of an ohm, and there is, consequently, with a current of 1500 amperes, a potential difference of 1.5 volt between



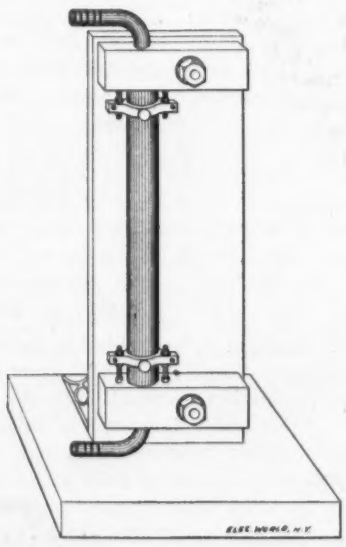


Fig. 2. Water-Tube Resistances. Fig. 3.

its terminals. The dimensions are 11 inches by 11 inches base, and 18 inches height. The water used in carrying off the heat generated by a current density of 15,000 to 20,000 amperes per square inch, is obtained from the ordinary supply by means of a small rubber hose pipe.

The Westinghouse Electromagnetic Railway Switch.

In our issue of June 22 we published a general description of the Westinghouse electromagnetic railway system, and herewith give a detailed description, borrowed from our English contemporary, the *Electrician*, of the underground switch, the function of which is to make and break connection between the contact studs and the mains. Figs. 1 and 2 give side and end views of the switch.

There are two magnet-coils, one wound with coarse and the other with fine wire, both acting upon one armature, which carries two carbon switch contacts. Each motor-car is provided with a couple of small accumulators, and when the car enters a given section of the track, current from these cells passes, by way of the sliding collector-bar beneath the car and one of the two wrought-iron studs between the track rails, through the fine-wire coil on the electromagnet in the switch-box, which controls that section, and thence to the earth. Immediately the electromagnet lifts its armature, thereby bringing into contact the two pairs of carbon contact-pieces (which are shown black in the illustrations). One pair of these carbons is permanently connected to the feeder, and the other is connected to the positive-contact stud between the tracks, against which stud the positive-collector bar of the car will by now have made contact. The negative collector-bar under the car touches, at the same time, the other stud, which is connected to the return-conductor. The lifting of the electromagnet armature, and the consequent closing of the carbon contacts, therefore, allows current from the feeder to pass through

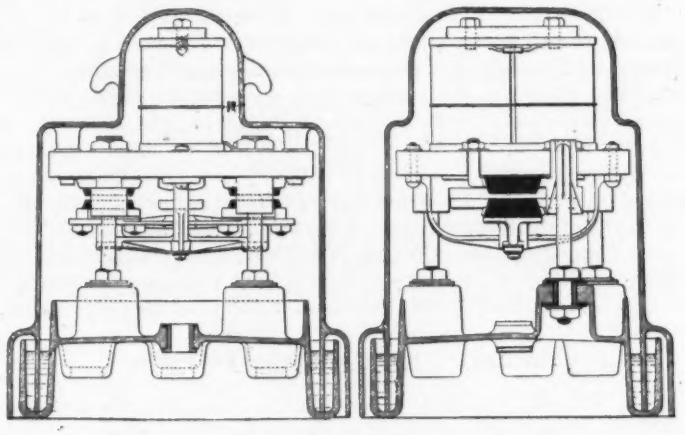


Fig. 1. Underground Switch. Fig. 2.

the car motors ; and this current is also caused to pass through the heavy-wire coil on the switch-magnet, which is connected in series with the motors, thereby insuring the retention in its "live" position of the armature. As soon as the car passes off the particular section from which it has been deriving power, contact between the collector-bars and the contact-studs ceases, breaking both the power-circuit and the auxiliary secondary cell-circuit through the electromagnet. At that instant, therefore, the magnet armature will fall, the carbon contacts will be separated, and the positive stud will no longer be in connection with the feeder. Before this occurs, however, the collector-bars have established connections through the contact-studs next ahead, so that the separation of the switch-contacts is not accompanied by any serious sparking.

The bare parts of the switch require to be kept free from dust and moisture, and in order to insure these conditions, the mechanism is inclosed in a diving-bell-shaped case, the lower edge of which dips into an annular oil-trench, sealing the case. This construction is clearly shown in the illustrations, and it is one which very effectively provides for the protection of the apparatus.

Technical Journalism.

Although it is only a short time ago that self-propelled carriages have been brought before the public, yet two journals have already been started in the interests of mechanically propelled road carriages —one in England called the *Autocar* and another in New York under the name of *The Horseless Age*.

A Correction.

In the article on "Electricity in the Italian Navy" in our issue of Oct. 12, on page 397, about the middle of the column, "leather" instead of "copper" should be read in the sentence referring to the Raffard coupling.

The Madison Avenue Storage-Battery Equipment.

THE New York & Harlem Railway Company, which has decided to introduce the storage-battery system in an experimental way on its Madison & Fourth Avenue line, has already had some experience in accumulator traction. Julien storage-battery cars were operated on the line a few years ago, and their subsequent abandonment was attributable not so much to the failure of the system as to unfortunate litigation. In the present instance two cars are being experimentally tested, nine-plate cells of the chloride type being used.

The trucks, which are of the Peckham type, specially constructed for the purpose, are extra long and unusually substantial. The motors are hung from the axles on the sides opposite to those which they occupy in the ordinary equipment, as shown in Fig. 4, and are of the G. E.-800 type, being wound for 120 volts. The middle of the truck is left free to receive the equipment of batteries, which are carried as shown in Fig. 7. The storage cells are 60 in number and are grouped in two batteries of 30 each. The controller is a modification of the General Electric K-type, and has six notches arranged in pairs, making connections, as shown in Fig. 5. Nos. 1, 3 and 5 are running notches, and when these positions are used the car gives the maximum economy. Each of the chandeliers in the cars is connected to one of the batteries, so that in case of trouble with one battery the other will be available to furnish illumination. Each equipment is provided with a special box containing voltmeter contacts, so that the expert can always determine the condition of the batteries and ascertain if sufficient charge is present to furnish power for operating the car until it returns to the charging station again.

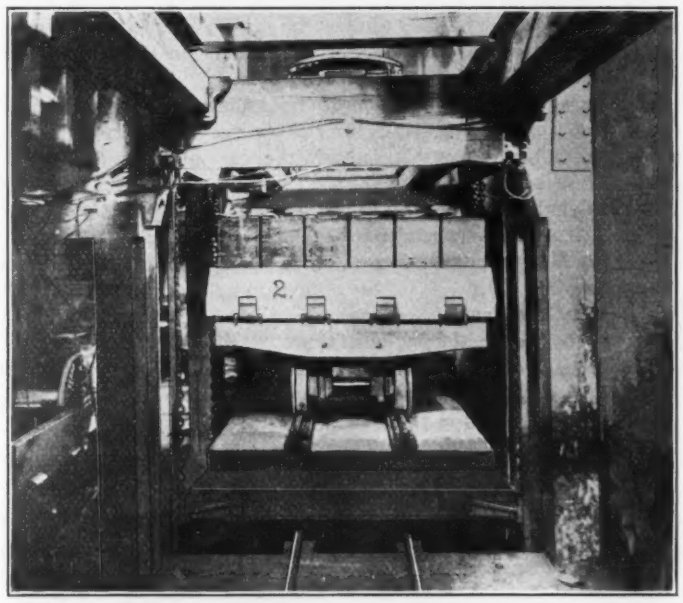


FIG. 1.—BATTERY TRUCK ON ELEVATOR.

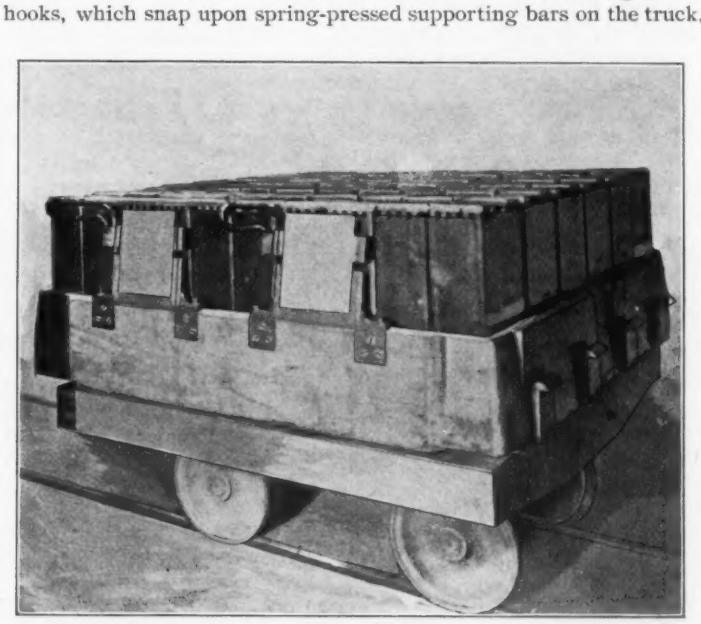


FIG. 2.—TRUCK AND BATTERIES.

The generating plant is located at Eighty-sixth Street and Madison Avenue, a part of the car barn at this point having been set apart for the purpose and the necessary equipment installed. Provision has been made for quickly furnishing cars with charged batteries and for as speedily removing the discharged cells. It has already been stated that the 60 cells occupy a position in the centre of the truck.

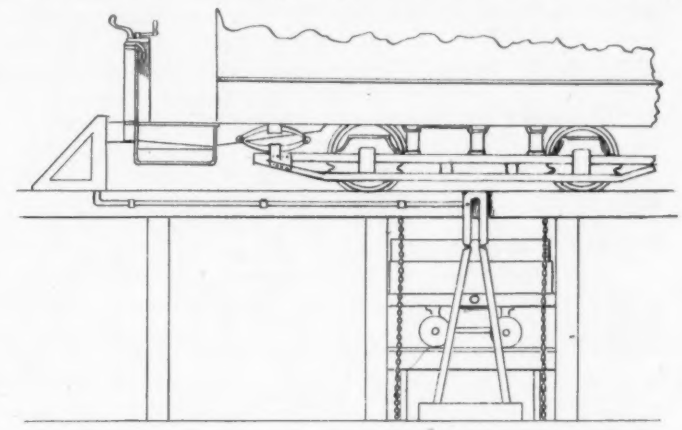


FIG. 3.—CENTERING APPARATUS.

They are carried in a tray, to the bottom of which are attached four channel irons. To the ends of the latter are riveted wrought-iron hooks, which snap upon spring-pressed supporting bars on the truck, holding the tray securely in position. The cars enter on the street level, and the cells are raised on the way from the basement into position by means of an elevator, Fig. 1, operated by an electric motor.

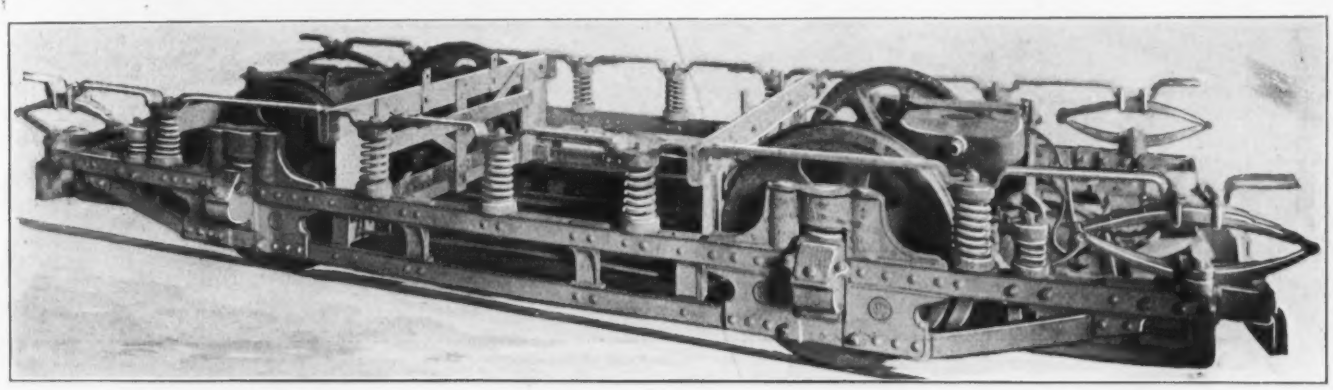


FIG. 4.—CAR TRUCK WITH BATTERIES REMOVED.

It is obviously necessary that the elevator should carry its tray exactly into position. As it would be out of the question to stop a heavy car within an inch or two of the required point, an automatic

centring arrangement, Fig. 3, which consists of a movable bumper on the car track capable of adjustment for a distance of about 14 inches, has been devised. From the bumper a lever extends to guides at the side of the elevator pit. The movement of the lever is communicated to the guides, and they are caused to swing longitudinally into such a position that the tray slides as it is raised into its proper place, and the hooks hold it securely.

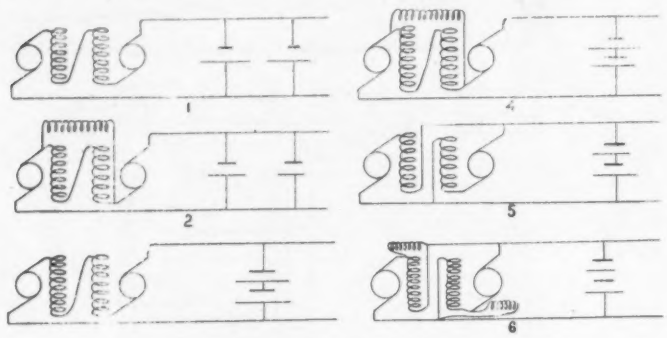


FIG. 5.—CONTROLLER POSITIONS.

Upon the withdrawal of the elevator the car is ready for service. The removal of the discharged cells is as easily effected. The elevator is raised into position, the supporting hooks are released and the batteries then rest on a truck, Fig. 2. The elevator carries its load to the basement, and the cells are run into the charging room. It is stated that the batteries can be changed in 30 seconds.

The terminals of the battery make automatic contact when it is

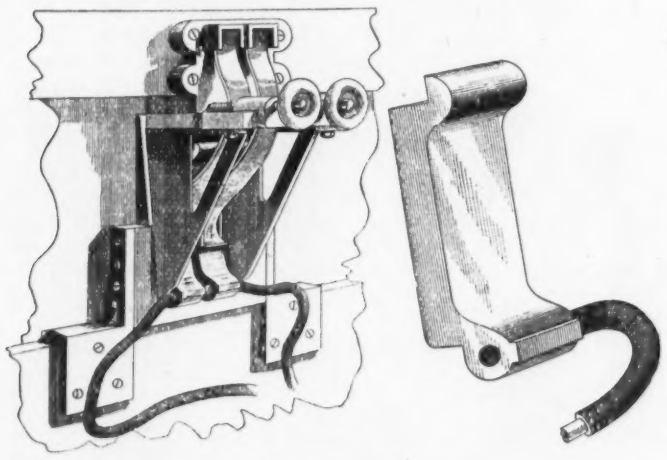


FIG. 6.—DETAILS OF CONTACT.

hoisted into position, the mechanism for this purpose being illustrated in Fig. 5. A flat, brass plate on the side of the battery box impinges against two blocks similar to that shown in Fig. 6, the latter being held against cross plates on the sides of the tray by flat springs, as shown in the cut. These blocks are absolutely insulated from any part of the mechanism which presses them against the plates. The tension of the flat springs is readily adjusted by two tension screws. Two of these blocks connect one terminal of the battery, an identical apparatus being used for the other connection. It is a fact worthy of note that in the arrangement of the cars all parts of the equipment are in duplicate, so that the possibility that it may become disabled is reduced to the minimum. All the battery connections are burned together and the terminals are double cables.

The generating plant consists of a 21-hp gas engine and a 16-kw General Electric generator, but the company hopes to add a 36-hp Otto gas engine, and a 30-kw generator within two weeks. The batteries are charged in series and interposed in the circuit are two cut-outs, one of which acts if the current falls below 10 amperes, and another if the current rises above 100 amperes. This makes the charging of batteries almost automatic. The charging switchboard is of polished slate and consists of five panels, each containing a switch and an ammeter. The totalizing ammeter and voltmeter together with the cut-outs before mentioned complete the present equipment.

When the system is introduced on a larger scale it is proposed to vary the battery equipment of the cars. A car traversing a route without grades will carry, for example, a lighter weight of batteries than one which must surmount grades and travel over slippery rails.

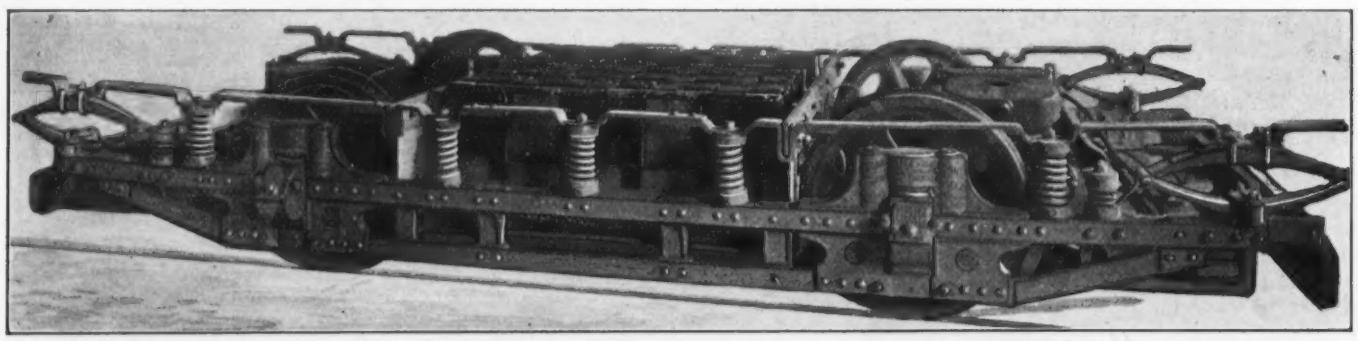


FIG. 7.—CAR TRUCK WITH BATTERIES IN PLACE.

Magnetization of Iron.

BY H. S. WEBB.

On page 499 of THE ELECTRICAL WORLD of Nov. 2 is an abstract of an article by Prof. Zickler in which he uses a quantity, S, which he calls specific magnetism or magnetism per unit volume; and another quantity, K, which he calls coefficient of magnetization. The former quantity is probably better known to English and American readers as $\mathfrak{I}$, the intensity of magnetization, and was defined by Ewing a number of years ago as the magnetic moment per cubic centimetre, or as the pole strength per square centimetre of sectional area.

Likewise K has long been known as the magnetic susceptibility and is the ratio of the intensity of magnetization to the magnetic force producing it, usually represented by κ.

His idea of imagining the iron to be rapidly withdrawn from the solenoid, so that the number of lines cut by the secondary coil is $4\pi\mathfrak{I}$, would be practically possible only in the case of a rod, and not for rings such as he seems to have used. Since we are accustomed to use $\mathfrak{B}$ as equal to $4\pi\mathfrak{I}+\mathfrak{H}$, it would be better to say that $\mathfrak{B}-\mathfrak{H}=4\pi\mathfrak{I}$ and that $\mathfrak{H}$, which, especially for irons having a high permeability, is very small in proportion to $4\pi\mathfrak{I}$, could be neglected without serious error. In other words, $\mathfrak{C}$ is only approximately equal to $4\pi\mathfrak{I}$. This is evidently the way he figures $\mathfrak{B}$ in his experiments or else he corrects $\mathfrak{B}$ by subtracting $\mathfrak{H}$ each time.

From a table or curve (which I have convenient) the following three values of $\mathfrak{B}$ and $\mathfrak{H}$ are taken:

$\mathfrak{B} = 71$ when $\mathfrak{H} = .18$;
$\mathfrak{C} = 8940$ when $\mathfrak{H} = 4.05$;
$\mathfrak{B} = 16600$ when $\mathfrak{H} = 64.33$.

This gives in the first case, where $\mathfrak{B} = 71$, an error of about .3 per cent. by calling $\mathfrak{B} = 4\pi\mathfrak{I}$ instead of equal to $4\pi\mathfrak{I} + \mathfrak{H}$. In the second case, where $\mathfrak{B} = 8940$, the error is only .05 per cent., and in the third case, where $\mathfrak{B} = 16{,}600$, the error is .4 of 1 per cent. So the error introduced into $\mathfrak{B}$ by neglecting $\mathfrak{H}$ is very small up to and including a value of 16,600 for $\mathfrak{B}$. Beyond that value the percentage error would increase rapidly, because $\mathfrak{H}$ increases much more rapidly than $\mathfrak{B}$.

From experiments we know that $\mathfrak{I}$ apparently has a limiting value different for different materials, but $\mathfrak{B} = 4\pi\mathfrak{I} + \mathfrak{H}$ has no limiting value as long as $\mathfrak{H}$ can be increased, as is evident from the equation. Therefore it is $\mathfrak{B} - \mathfrak{H}$ and not $\mathfrak{B}$ which can be said to have a limiting value.

While using $\mathfrak{B} = 4\pi\mathfrak{I}$ would give Prof. Zickler's curve sufficiently correct for the greater part of the curve, it would not hold so well for that part of the curve where the iron is highly saturated.

Electroplating Ships.

It is well known that unless an ocean-going vessel is plated with copper below its water line, barnacles and other animal and vegetable matter will accumulate on the wetted surface and very considerably increase its resistance, thereby reducing the speed of the ship. Moreover, if the vessel be of iron or steel, a corrosive action

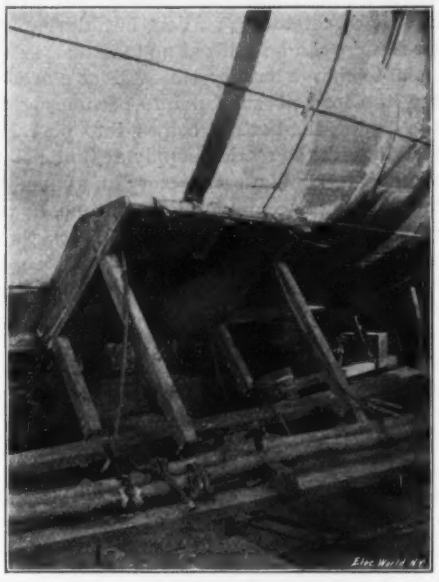


FIG. 1.

takes place which shortens the life of the hull. The above growths often extend to a thickness of two inches or more, and on the large ocean liners as much as 23 tons are not infrequently removed at one docking, and the cost of docking for this purpose and cleaning often exceeds $12,000. The desirability of a method of coppering a vessel by which the copper can be applied directly to the steel shell without the interposition of a wooden sheathing, is therefore evident.

A solution of this problem is presented by a company which has erected a plant at Jersey City, and consists in an electrolytic method of depositing copper on the plates, which coating adheres so firmly as to make its a removal a most difficult matter; in fact it is claimed that the copper becomes practically a part of the steel plate when the

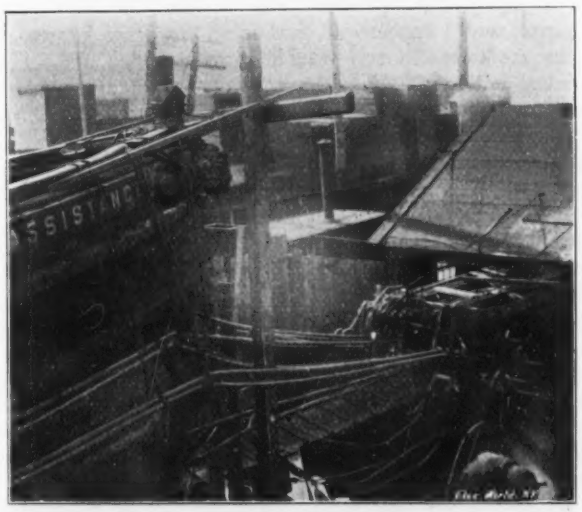


FIG. 2.

process is complete. The copper is applied to the completed vessel and not to the separate plates, and hence existing vessels may take advantage of this method to save dockage. Nor is the privilege confined to steel vessels alone; for wooden vessels may be coppered by this method by first applying plumbago to their sides.

To prepare the sides of a steel vessel for receiving its coat of copper, shallow baths are built, which are rectangular in shape and open on one side. These baths are made water-tight by means of a coating of tar, and are provided on their edges with heavy soft rubber gaskets. In the bottom of the bath are two pipes, through which the electrolyte is circulated. The bath is held up against the side of the vessel by poles, as shown in Fig. 1. It is first filled with a pickling mixture composed of dilute sulphuric acid, and this remains in contact with the plate about twelve hours, after which it is removed and the plate scoured with sand and soda.

If a sulphate bath should now be applied to this place a coating would be deposited, it is true, but due to the free acid of the mixture the coating would readily peel off. To avoid this, a preliminary coating is deposited, using a cyanide instead of sulphate of copper. About twelve hours suffices to deposit this preliminary coating. Copper electrodes are placed in the bath and connected to the positive terminal of the dynamos, which completely surrounds the boat and is insulated from it. The negative terminal of the dynamo is firmly connected to the plating of the boat itself.

The current for depositing the preliminary coat is about five amperes to the square foot, requiring a pressure of about five volts. Each bath averages 60 square feet. After removing the cyanide bath the place is thoroughly washed and scrubbed with steel brushes, and the sulphate bath is then applied. The current for this bath is of the same intensity as for the cyanide bath, but the voltage, due to the lower resistance of the solution, need only be half as great. The sulphate bath is applied for 48 hours, and the coating allowed to reach a thickness of three thirty-seconds to one-eighth of an inch. The conditions are such that any number of baths may be applied to the vessel, and, therefore, the process is continuous, and the actual time of plating does not make so much difference. The present method is to run two large mains around the boat to convey the electrolyte, one a feeder and the other a return. Each bath taps on these mains from its two pipes, and a small steam pump pumps the sulphate of copper through the pipes and thence to a reservoir, only to be pumped over again. Thus the baths are kept continually agitated. At the forward end of the boat a stand pipe is erected, to maintain an approximately constant pressure to the mains.

The present plant of The Ship Copper Plating Company, which has been formed to apply the process described, is situated in Jersey City near Cortlandt Ferry. At present work is being done on a small tugboat, the plating of which is nearly completed. About five tons of copper will have been deposited when the work is completed. The plant consists of four dynamos of 10 hp each; three of the dynamos deliver current at a pressure of two and one half volts, while the fourth delivers at a pressure of five volts and is used for the cyanide baths. The fields of the dynamos, although primarily intended to be self-excited, it has been found more convenient to excite from the higher voltage machine. The back E. M. F. of the

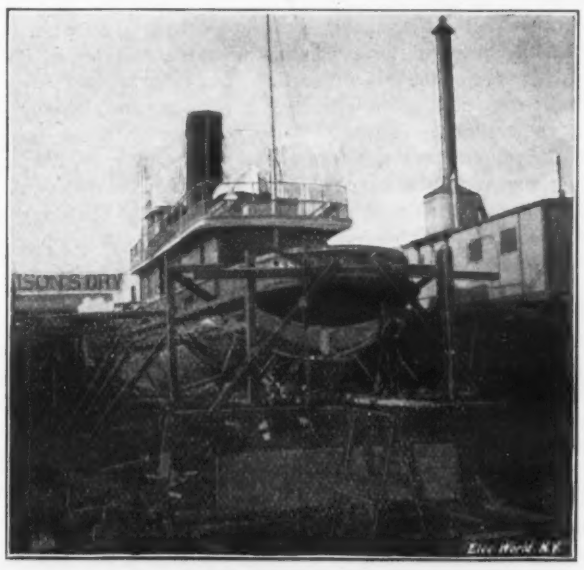


FIG. 3.

fields when the dynamo is shut down is surprisingly large, a current of nearly 100 amperes at one half a volt having been observed flowing back from the dynamos under these conditions. The machines run at a speed of 1000 revolutions and have plain shunt fields. The voltage is regulated by a sliding rheostat, and as there are no interval contacts the regulation is very accurate. The machines are the well-known Excelsior make. The copper feeders, as before stated, completely surround the boat and are very massive, as may be seen from Fig. 2. Figs. 2 and 3 show the bow and stern of the boat respectively, and incidentally show several tanks or baths and their manner of application. The propeller and rudder are electroplated in separate baths of their own, the latter being shown in Fig. 3.

Storage-Battery Applications.

The discussion of storage-battery applications before the American Institute of Electrical Engineers, on Wednesday evening of last week, was opened by the reading of a communication by Mr. Arthur E. Childs, the stated object of which was to present to the Institute the main facts and considerations concerning the application of accumulators in electric generating stations, both for light and power.

It is an acknowledged fact, the author said, that the great variations and fluctuations of the load on power, circuits, especially those power-circuits supplying trolley lines, are among the greatest difficulties which engineers have to contend against, and any appliance which will aid them to arrive at a satisfactory running of their station is regarded with favor. It is only in the ranks of those short-sighted engineers, where ignorance and prejudice are the rule rather than the exception, that there are found men who will refuse to consider the storage battery as an auxiliary.

Mr. Childs explained that in his communication the term "variation" was used to designate the change of current produced by the adding of lights on to a lighting station, or the cars or motors on to a power station, and the term "fluctuation" was used to indicate those rapid and necessary changes of current taking place on the outside line, due to stopping or starting of cars, or throwing on or off of stationary motors. By the "type" of battery, he said, is meant the slow-discharge battery for a long period of service, or the rapid-discharge battery for a few hours, or even less time of discharge.

In the lighting station, he continued, if we bear in mind the usual form of curve, it will be remembered that the instantaneous changes of current are minute and almost imperceptible compared with the steady increase or diminution of the total current of the station. Comparing the lighting curve with the usual form of power-station curve it will be noticed that the instantaneous changes of the current are enormous compared with that in the lighting-station curve. There is a similarity in the two curves in the fact that at certain hours of the day more cars are operated than at other hours, thus producing a general rise in the level of the power curve corresponding to throwing on of a number of lights in the lighting curve.

The introduction of a storage battery into a central station acts in a certain sense as a buffer between the external load and the dynamos, taking the shock of the variations without throwing the same on the engines, and has the effect of reducing the average percentage variation in load on the dynamo from a large amount to a very small one, making the operation of the machines more efficient. In fact, a storage battery acts as a regulator in this instance, maintaining as it does a constant voltage at the switchboard. This introduces the question of the efficiency of engines with varying loads; and, leaving out of account the reports by engine builders, who are naturally interested parties, it is a fact that not many extended and careful investigations of efficiency under varying loads have been carried out. Prof. W. C. Unwin, of the Central Institution, at South Kensington, has shown, however, that a decrease of mechanical efficiency has a serious effect on the economy of working with a variable load, and with a load varying from 100 per cent. to 25 per cent. the efficiency decreases from 85 per cent. to 40 per cent.

As applied to power stations, and especially where water-power is used, the author considered storage batteries almost indispensable, and said he knew of several plants where the successful maintenance of a constant voltage on the machines is dependent upon the fact that an attendant sits by the governors of the wheels and regulates them by hand, the best water-wheel governor that has ever been produced not being capable of satisfactorily meeting the rapid changes in load. The stations in mind, he continued, are not small stations, as might be supposed at first thought, but are stations where several thousand horse-power and over are generated at certain hours of the day; and it is surprising that engineers of intelligence are still allowing their prejudices to prevent them from investigating the merits and value of accumulators as regulating governors in their stations.

Mr. Childs mentioned the advantages to be obtained by the use of accumulators in railway power houses to straighten out the enormous fluctuations in load, and also referred to the application of storage batteries to illuminating plants, mentioning as notable instances the New York Edison Illuminating Company, the Edison Illuminating Company of Boston, and the Lawrence Gas Company, Lawrence, Mass. In the latter case, he said, the battery is used in connection with the Edison three-wire system for carrying the peak of the load during the busy hours of lighting, and the entire load at noon, when the large mills on the Merrimac at Lawrence shut down, backing up the water into the river above and entirely cutting off the supply to the wheels of the gas company, for some 25 or 30 minutes.

The storage battery can also be used, he said, as a valuable adjunct to both power and lighting stations at points in their systems where it is difficult to maintain the voltage at periods of heavy load. In these cases the feeders are usually not sufficient to carry the whole current direct to the station, but during the periods of small load the feeders can be utilized up to their maximum allowable drop in potential to charge battery sub-stations placed at these weak points. When the load at such points becomes greater than the capacity of the feeder, the battery comes into play and carries the load in connection with the station supply at that point, thus maintaining the voltage and doing satisfactory and valuable service.

Referring to the use of accumulators in Europe, he pointed out the fact that more than 20 lighting stations, and several thousand isolated plants in Great Britain alone, and in Germany 5000 isolated plants and 15 railway power plants, are using storage batteries. In fact, he continued, 80 per cent. of all the central stations in Germany and Austria are equipped with storage batteries. In addition to the above, there are many stations in France, Italy, Holland, Belgium, Sweden, Norway, Denmark and Spain, and two or three in Switzerland.

One point which has contributed largely toward the success of storage batteries in Europe is the fact that engineers have endeavored to obtain long life and high efficiency even at the expense of increased first cost, and instead of attempting to obtain a large output per pound of element, they have limited themselves to a reasonable number of ampere-hours per pound. The result of this has been that the batteries in use in Europe have shown great endurance and solidity. The experience, however, which has been obtained with many American batteries has not been so promising as on the Continent, owing to the lack of proper appreciation of them. It would be greatly to the advantage of American engineers if they would follow the lines laid down by their European confreres; and if, instead of waiting for some marvelous development in the manufacture of storage batteries, they should make use of the existing high class and efficient batteries, and by using them in a reasonable manner they would obtain valuable and even remarkable results.

Considering the efficiency of a storage battery, the author said the factors would tend to reduce it—loss in voltage and quantity of current—are not so serious as they have been in the past, and manufacturers are at present able to guarantee a very high efficiency. In cells which were submitted to Prof. H. L. Callender, he stated, an ampere efficiency of 96.1 per cent. was recorded, the watt efficiency being 84 per cent. In certain instances, however, known to the writer, these efficiencies have been slightly exceeded, and complaints from central-station managers that they cannot obtain efficient cells are now groundless, as with the efficiencies named, an eminently satisfactory service can be obtained. It must be borne in mind that a loss of 16 per cent., or even 20 per cent. in the efficiency of the battery does not mean the loss of the same percentage in the output of the station, as the battery usually supplies, approximately, or even less, of the whole output in watt-hours, and it is, therefore, from that fraction of the whole output that the loss in the battery must be deducted.

Concerning the matter of cost of maintenance of a storage-battery outfit, Mr. Childs stated that it is now usual for the manufacturer to guarantee a fixed annual percentage, varying from 10 per cent. in small plants to a smaller percentage in large plants, depending, of course, on the conditions of operation and the use to be made of the battery, a study of which will soon determine what percentage can be guaranteed. In first-class plants well installed and operated by careful engineers, the cost of maintenance can be reduced to the vicinity of 3.5 or 4 per cent. It is customary for the manufacturers to enter into a contract, in the case of large plants, guaranteeing that the cost of maintenance shall not exceed a certain percentage per annum for the period of contract. This can be carried out in two ways. Either the lighting or railway company can pay the manufacturer the percentage specified, every year, and the manufacturer will inspect and keep the battery in first-class condition; or the company employing the batteries can inspect and order renewals themselves, in which case should the cost of maintenance exceed the percentage guaranteed, the manufacturer will not charge more than the specified amount. This is an exception rather than the rule, however, as the cost of maintenance is usually somewhat lower than that specified by the

manufacturers, so that the company owning the battery is the gainer by the difference in percentage. By a thorough attention to details, both large and small, the percentage can be kept down to a very low figure; and it is to be regretted that the practice of engineers which prevails in Europe of treating the battery with care and consideration does not seem to exist among the engineers of this country, to the detriment of their own lighting or railway plants.

It must not be assumed from the above, he continued, that storage batteries require an inordinate amount of care and trouble. On the contrary, they do not require either great expense or care. All that is demanded is regular and systematic attention on the part of those having them in charge. When such care is exercised, it is found that batteries perform a very valuable service, and largely reduce the operating expenses of the station—in many cases as much as 30 to 35 per cent. This reduction in operating expenses is, of course, due to the saving in cost of coal consumed, a saving which could not otherwise be obtained. Where water-power is employed, a storage battery enables the water-wheels to be operated for 24 hours, storing current while the station output is reduced to a minimum, and aiding the station during the busy hours of the day. In many cases this practically doubles the output of the station without increasing the cost of installation to a corresponding amount. In many cases where water-power is used it would be impossible to double the generating capacity of a station, as there would not be enough water at hand to give double the power. This is especially true in those sections of the country where the power of small streams has been utilized and where the flow of water is continuous but not very great. In addition to the action of the storage battery as a receiver for storing the current while the station is not giving a large output, it also maintains, during the operation of the station, a perfectly uniform voltage which would not be obtained with the varying load direct upon the water-wheels, on account of the difficulty in governing previously mentioned.

When an entirely new power-plant is to be built, the writer had no doubt that by adopting the storage battery in the first instance, the initial cost of installation would be less than for the plant not using storage batteries, and the cost of operation of the station will certainly be much reduced when the station uses storage batteries. In the case of existing plants which have to be extended, it has been proved that a kilowatt-hour capacity can be added more cheaply to the station by the addition of storage batteries than by the addition of generating machinery; while, of course, the cost of operation is much reduced.

Referring to the primary cost of storage batteries, he stated that the cost per kilowatt-hour output is relatively greater for small cells than for large ones, since the cost of manufacture is reduced per kilowatt-hour in the larger sizes, whereas the jars and tanks which are used to hold elements do not decrease very much with the decrease in size of the elements. The cost of shipment and erection are, of course, slightly less per kilowatt-hour with the larger sizes than with the smaller ones, and, on the whole, the cost per kilowatt-hour with the larger cells is less than with the smaller sizes. It is stated by the Electric Storage Battery Company that it is now installing large plants of Tudor type at a cost per kilowatt-hour of about $37 to $40, which cost, it is understood, can be reduced in the larger stations. The question of cost, however, he concluded, is one which must be studied out in each case where it is proposed to install storage batteries.

Mr. Childs' communication was followed by one from Mr. C. L. Edgar, presenting his experience with accumulators in connection with the large direct-current incandescent lighting station in Boston.

Mr. Edgar assumed, at least for the purpose of this communication, that the perplexing questions which had so long involved storage-battery construction had been disposed of, and that engineers in this country were now on equal ground with those across the Atlantic. He thought that the uses of accumulators might be classed under four principal heads, namely:

1. *To carry the peak of the load.*
2. *To carry the entire load at minimum hours.*
3. *To act as an equalizer or reservoir.*
4. *For the equipment of annex or sub-stations.*

Referrring to the use of batteries for carrying the peak of the load, he called attention to the fact that in all lighting plants there is a considerable part of the load which is present during a very small portion of the day—about two hours—during the Winter months. This is due to the fact that a great many stores close at 6 o'clock in the evening and do not require light after that time, but do need it from dusk (which comes about 4:30 during the months referred to) until closing time. The presence, he said, of a large day load of motors, or a large night load, as of street lamps, did not affect the peak further than to change the height of the curve at those hours. Mr. Edgar thought it safe to assume that the peak of the load would represent from one third to one half of the total maximum load of a station, and stated that the company with which he is connected had found that one half of the maximum load on the plant existed for about two hours per day ordinarily, and four hours under exceptional circumstances for the five winter months, and that the energy in kilowatt-hours generated for this short-period demand represented only about 10 per cent. of the total number of kilowatt-hours for the year, 90 per cent. being steady load. This result, he said, went to prove the position taken by some engineers who had declared that a very large station could profitably be equipped with two types of apparatus, one half to be of the very best obtainable, and the other half cheap and comparatively inefficient but reliable machinery; the high-grade equipment to handle the steady load and the cheap apparatus the intermittent or "peak" load. The object in this would be the saving in interest on the cost of the cheap apparatus, which, he stated, exceeded the greater cost of operating this apparatus, because of the small proportion of the working hours during which it would be in use. Mr. Edgar considered that the application of storage batteries in such a case was obvious, and his company had installed them to meet the conditions specified—namely, to take care of the peak of the load.

Discussing the second head, *Carrying the entire load at minimum hours*, Mr. Edgar thought that the nature of the load curve in America was against the use of accumulators for this purpose, the period of minimum load being too short to save a shift of men, or to save very much by banking or drawing fires. Experiments made by his company had demonstrated that running the engines 24 hours a day, charging the batteries during minimum load hours and having them take the peak during maximum hours was more economical than shutting down the engines and carrying the load with the batteries during minimum hours.

Considering the storage battery as an equalizer or reservoir, the writer said his company had been particularly pleased with results obtained from the use of accumulators in thi smanner. It enabled one to foretell just what the load would be, and elliminated the necessity for starting up or shutting down generating sets as the load increases or falls off. His practice was to keep the battery constantly connected up with one or another or all bus-bars, where it may be called upon at any moment to give or receive anywhere from one to 3000 amperes, and he had found it practical by this means to operate the engines at never less than three-quarters load. He had found that the losses in the battery are compensated for more than four-fold by the increase in steam economy, and thought it impossible to overestimate the advantages of storage batteries for imparting reliability and furnishing regulation to a distributing system.

The use of accumulators for the equipment of annex stations, the writer stated, had not been practically investigated by his company, but he thought storage batteries would be particularly advantageous where the generating station could be located on some nearby water front, and small distributing stations scattered throughout the city, the distributing stations being equipped with accumulators. In closing, Mr. Edgar said that his communication was intentionally written upon somewhat narrow lines, because so much had recently been written upon generalities that he deemed it advisable to brush these aside and confine himself to specific cases.

Mr. Nelson W. Perry then read a communication, the title of which was "Storage Battery or the Gas Engine as an Auxiliary."

Mr. Perry said that the question of whether it is economical or not to equip a central station with an auxiliary storage-battery plant, is one which must be decided separately for each particular installation. Generally speaking, he said, the question will be decided by the character of the load-line—a broad-topped curve being the most unfavorable and a sharp peak the most favorable to storage-battery economy. Again, a station having a very light day load may use the battery to good advantage, even though its night load may present a broad-topped aspect. Aside from purely economic reasons, he continued, convenience may control, so that it is impossible to state, unless all the conditions are known, whether the storage battery is advisable or not.

The price of the battery, he stated, was an important element, but less so than popularly supposed, for the space which it occupies and the cost of maintenance may largely overbalance any gain in first cost over the cost of the extra boiler, engine and dynamo.

In regard to the cost of maintenance, Mr. Perry stated that manu-

facturers are willing to guarantee it not to exceed 10 per cent. per annum, but it is well to understand just what this 10 per cent. means. It means, he continued, that if you put in all the battery power that the manufacturer recommends, and take care of the battery exactly as he says, then the guarantee holds good. Under such conditions the manufacturer is undoubtedly safe, but if we install a plant under these conditions we are pretty sure to find that the economy in first cost of the battery over engine and dynamo has entirely disappeared.

There are some situations, he said, in which either convenience or extreme steadiness of current may control the question of the use of storage batteries. But where the question is one purely of economy, he would not recommend their use under any circumstances, simply because there was a still more economical method at hand; namely, the gas engine. Even if it were necessary to use illuminating gas from the street mains, he considered that it would be more economical (considering space and other factors), to take the peak of the load with a gas engine than to install a battery for this purpose, as in this case there would be no standby losses, and the engine would be ready at a moment's notice to be thrown into service.

It is a fact that has been amply demonstrated, he said, that a given number of lights can be produced with half the gas burned in a gas engine that is required to produce them in ordinary burners. The mechanical efficiency of the gas engine is not quite so high as that of large compound condensing steam engines, rarely ever exceeding 83 to 85 per cent. while the latter may go to 90 per cent., but the total efficiency from fuel to the pulley of the gas engine is about double that of the steam engine—reaching 25 per cent. under favorable conditions, whereas, with the steam engine it rarely equals 12 per cent. So that with the gas engine operating at anywhere near its full load, there would be a gain in efficiency, instead of a loss of say 20 per cent. where the battery was used.

As indicating the performance of a gas engine using illuminating gas at various loads, he quoted some figures obtained from a test of a 12-hp (actual) gas engine, showing a gas consumption varying from 15 cubic feet at 12 horse-power to 48 cubic feet at 1 horse-power. These figures are somewhat better, he admitted, than would be obtained in practice, but go to show that the gas engine compares favorably at light loads with the steam engine under similar conditions.

Thus far the author had spoken only of illuminating gas, and he drew attention to the fact that power may be much more cheaply generated by using a fuel gas. The cost of producers or generators he gave as about $11 per horse-power capacity, and an idea of the space required was taken from a statement of Mr. J. Emerson Dowson, who in estimating for a plant of 400-kw capacity had said that if the gas plant is all on one level it would occupy a ground space of 27 feet x 54 feet, but if necessary, all except the gas holder can be placed under or over the engine room. Mr. Dowson's estimate for such a plant is, including erection, foundations and ash-pit for generators, $5500, or $10.38 per horse-power.

These fuel gas generators, Mr. Perry continued, can utilize advantageously the poorest grades of fuel, and produce from the better grades of anthracite about 160,000 cubic feet of gas of a calorific value equal to one quarter that of 16-cp illuminating gas per ton of coal. Referring to the standby losses of the gas producers, he quoted data to show that they are insignificant when compared with the standby losses of the steam boiler.

Mr. Perry next discussed a situation usually considered, he said, peculiarly adapted to the storage battery, namely, in subordinate or outlying stations where they are charged during the day time from the central station and act as centres of supply during the night time. He thought, however, that gas could much more economically be distributed to these stations than can the electric current, for Mr. Denny Lane had shown that with ordinary 16-cp gas, 3000 horse-power can be sent a mile for an expenditure of 1 hp, or 1-30th of 1 per cent. of the power conveyed. The author stated that his own calculations show that a 6-inch pipe will deliver 6000 cubic feet of gas per hour at a distance of 10,500 feet under four inches of water pressure. If this be 16-cp gas, allowing 25 cubic feet per horse-power-hour, this quantity represents 240 hp. Cast-iron pipe, 6 inches in diameter, having a thickness of ½ inch, weighs, 31.9 lbs. per foot. The total weight of this two miles (nearly) of pipe will therefore be 334,950 lbs. This would be equivalent in conductivity to about 41,869 lbs. of copper. But four miles of copper weighing 41,869 lbs. would be equivalent to about four No. 000 B. & S. wires, which would have a resistance for the four miles of 0.325 ohm. If the charging current were transmitted at 220 volts there would be required a current of 848 amperes; but a wire having a resistance of .325 ohm will only deliver under a pressure of 220 volts $220 \div .325 = 677$ amperes; there would, therefore, be required five No. 000 B. & S. wires to deliver this energy, and the weight of this would be 53,540 lbs.

If the distribution took place at 1000 volts, he continued, the amperes required would be approximately 180. To deliver this at the same distance with a loss of 10 per cent. would require 6264 lbs. copper, and to deliver it 1 per cent. less would require 62,642 lbs., which would cost far more than the pipe and still give less efficient transmission. He thought it would be very easy to prove that the gas engine, with fuel gas, would prove a much more economical auxiliary to the central station for taking the peak of the load, and the loads amounting to fractions of a unit, than the storage battery.

A communication by Prof. F. B. Crocker was then read by the author. Mr. Crocker's communication covered very much the same subject-matter as was discussed by Mr. Edgar's communication, and the author therefore omitted in the reading such parts as duplicated parts of Mr. Edgar's paper.

Prof. Crocker divided the principal uses to which accumulators may be put in electric lighting into the following classes:

1. To supply portable electric lamps.
2. To take up fluctuations and thus steady the voltage or current.
3. To furnish energy during certain hours of the day or night and enable the machinery to be stopped.
4. To aid the generating plant in carrying the heavier load, which usually exists for only an hour or two
5. To make the load on the engines more uniform by charging the battery when the load is light.
6. To transform from a higher to a lower potential by changing the battery in series, and discharging it in parallel, or *vice versa.*
7. To sub-divide the voltage and enable a three- or a five-wire system to be operated with a single dynamo.
8. To supply current from local centres or sub-stations.

Each of these applications he considered separately in the above order.

1. *Portable Accumulators.*—The accumulator, the author stated, is practically the only means of supplying electric portable lamps or those which are not connected to a dynamo even if they are stationary. The serious drawback with portable accumulators is their great weight. For example, a standard size which weighs 100 pounds, yields ten volts and five amperes, or 50 watts for 10 hours, which is just sufficient to feed one ordinary incandescent lamp of 16 cp. This weight would be prohibitive in most cases, in which the only way to carry the battery was by hand, but it might be allowable for lighting railway trains where the weight would not be so objectionable.

2. *Accumulators for preventing fluctuations*, due to unsteadiness in the driving power, are often applied successfully. A dynamo driven by a gas engine, for example, may vary periodically in speed because of the explosive action of the gas in the cylinder, and a battery connected in parallel with the dynamo will have the effect of steadying the voltage. But improvements in design and construction, he continued, tend to reduce unsteadiness of speed, and by the use of a heavy fly-wheel and an elastic connection between the engine and dynamo, the result is sufficiently satisfactory in most cases to make a battery unnecessary. An accumulator is generally installed in connection with a small gas-engine lighting plant to enable the engine to be stopped for a considerable portion of the time and save labor and attention, in which case the battery may also act to prevent fluctuations, but its principal function is the former one.

3. *Accumulators to enable machinery to be stopped during certain portions of the day or night* The advantage of this application depends upon the fact that in almost every electric-lighting plant there are long periods during the day and late at night when the number of lamps lighted is so small that it may not pay to run the generating machinery.

This plan also allows the machines to rest and cool down, which greatly facilitates cleaning and repairing. In a hotel, residence, or on board of a yacht it may also be very desirable to stop the machinery and avoid the vibration and noise during the night. On the other hand, the addition of an accumulator to an electrical plant renders the latter heterogeneous, since the battery and its management differ so radically from the machinery and the handling of the same. It must also be remembered that the total investment is increased by the cost of the battery and its accommodation, because the generating plant is perfectly able to carry the load put upon the battery since, by hypothesis, this load is a light one. Hence the machinery might be run all the time, in which case the battery would be entirely

unnecessary, and sufficient rest of the machinery could be secured by using different machines for the periods of light load on successive days. These statements are based upon the supposition that the battery is not used to help the dynamos at the time of maximum load, since this case was considered separately.

4 and 5. *Accumulators to aid in carrying the maximum load and accumulators to maintain uniform load on the engines.*—As Mr. Edgar had covered these cases so thoroughly, Prof. Crocker passed on to the next class.

6. *Accumulators used as transformers.*—The writer pointed out that if the cells of a battery are arranged in series while being charged and in parallel for discharging, a high-voltage current will be required for the charging, and a low-voltage current will be given out, but the total amount of energy measured in watts is the same minus the loss of 15 or 20 per cent. which always occurs in accumulators. Such a method of transformation of potential, he suggested, might be employed in connection with long-distance transmission of energy, the current being sent over the line at high voltage and converted to low voltage by accumulators for local distribution. For potentials of several thousand volts, which are commonly employed in transmitting long distances, the number of cells required would be so great as to make this of doubtful practicability compared with the ordinary stationary or rotary transformers, but it would give uniformity in load and other advantages which may be secured by the storage of energy.

7. *Accumulators used for sub-dividing voltage.*—This application is similar in principle to the preceding. The most important practical case is that in which a dynamo of 220 volts charges a battery of corresponding potential and a three-wire system is supplied from the battery, the neutral wire of the circuits being connected to the middle point of the battery. This arrangement would avoid the necessity of running two dynamos and allow the battery to be placed in a sub-station near the districts to be supplied, so that it would only be necessary to run two conductors to that point instead of three. The same principle may be applied to the five-wire system.

8. *Accumulator sub-stations.*—The installation of battery plants at local centres which are charged from the main station, would enable some of the conductors to be saved in a three- or five-wire system, as already stated. It would also make it possible to reduce the size of these conductors because the current which flows over them could be kept practically constant, so that it would not be necessary to have them large enough to carry the maximum current consumed by the lamps, which may be several times the average value. This, of course, would give the same steady load on the generating machinery as if the battery were located near it.

Accumulators used for two or more of the above-named purposes.—Each of the different uses of the storage battery, the author stated, had been considered separately to avoid the confusion with which this subject is often beset, but as a matter of fact the employment of the accumulator for several of these purposes is the most common practice. As Mr. Edgar had stated, the combination of these different applications rendered a plant not only more economical, but also much more flexible. For example, the battery may be utilized to help out the generating machinery at times of heavy load or when the latter is partially or wholly disabled. It often happens that it is difficult to produce or maintain sufficient steam pressure, owing to poor draught or other circumstances, in which event a battery enables the boilers to be temporarily relieved of some or all of the drain upon them while the pressure is being raised to the proper point. It may also be necessary or desirable to shut down the machinery, or a portion of it, for a few minutes to make some repair, adjustment or change of arrangement, connection, etc.

It is also possible to feed some of the circuits from the battery while the others may be supplied at a higher or lower voltage by the machinery. In these and many other ways an accumulator may be a very convenien tadjunct to an electric-lighting system. The fact that it is so radically different from the machinery in its nature and action makes it very unlikely that the entire plant will be crippled at any one time, since the two sources of current are not exposed to the same dangers. An accident to the steam piping, for instance, might shut down all of the machinery, but it probably would not affect the battery, and, *vice versa*, an accident to the latter is not likely to extend to the former.

Mr. Carl Hering then read a communication entitled "Past and Present Obstacles in Storage-Battery Development."

Mr. Hering in his remarks said that the question which the engineer and constructor should discuss at present is not "Is a battery desirable?" but rather "Why is it that storage batteries seem to have been unsatisfactory?" and the question which concerns the capitalist is "Does it pay in dollars and cents to use the storage battery even if it is kept in a satisfactory condition by the makers?"

The latter question, he said, can be disposed of in a few words. If the makers guarantee to keep the battery in a satisfactory condition for a certain rate per annum, or if they rent them, then it becomes a mere matter of calculation for each specific case to find whether it pays, or not. In some cases it will be found to decidedly pay, in some it will be doubtful, and in some, decidedly too expensive. Limiting ourselves to this country and judging in a general way from a number of storage-battery installations, it would seem that the price at present (including, of course, the cost of maintenance) is such that in perhaps the majority of cases the margin of profit to the user is so small or so doubtful that it does not balance the supposed risk. The commendable practice of renting relieves the purchaser of this risk, which then leaves the question a mere matter of cost. A material reduction in the first cost and cost of maintenance would therefore at once turn the tables in many cases so decidedly in favor of the storage battery that there would be little doubt left as to the economy, and it would render the practice of renting necessary in most cases. Cheapness, therefore, is one of the most important points which affect the outlook of the storage battery.

Returning to the first question, "Why is it that storage batteries seem to have been unsatisfactory?" Mr. Hering said that condition applied only to this country, as probably thousands of tons are and have been in successful use abroad. In Germany for instance, almost every one of the large continuous-current central stations is equipped with a battery plant; in England they are used very largely for private plants, as also for central stations, and an English firm recently claimed to have sold a total of "six miles" of accumulators placed in one continuous row, and a French firm is stated to make several tons a day.

The chief reason why so few storage-battery plants exist in this country, he thought, was that the accumulator companies have for years been so busy fighting each other's patents and have spent so much money in this litigation, that they have had neither time nor money left to manufacture and install their batteries. But all this litigation had now come to an end, and this, together with the fact that many authorities now concede that for many if not most purposes, the unpatented Planté type of cell is the better, removes the chief obstacle in the storage-battery development in this country.

Mr. Hering enumerated the chief diseases of the accumulators as follows: Buckling, short circuiting, sulphating, disintegration and dropping out of the peroxide. Many inventors, he said, have thought that most of these may be cured by a process of opposing or resisting their disastrous effects as distinguished from preventing their occurrence. Buckling has been opposed by main strength, short-circuiting by porous insulating sheets between the plates, falling out, by inclosing or locking the peroxide so that it cannot drop out, etc. Mr. Hering doubted the efficacy of these methods, and considered that to attempt to prevent the almost irresistible force of expansion of the peroxide from exercising itself by confining the material in an inelastic frame is a formidable and almost hopeless task. The inevitable result is that one or the other must give way; if it is the peroxide, it will ultimately be crumbled by the pressure; if it is the lead, there will probably be buckling, or at least a separating of the contact surfaces at the subsequent contraction of the peroxide, and this inevitably results in the formation of that very objectionable layer of white sulphate which practically insulates the active material from its conductor, the consequences of which are sure to be fatal. The development of the storage battery has also, he considers, been greatly retarded by the fact that it was in the hands of mechanical engineers instead of chemists.

The careful constructor, Mr. Hering thought, should attack the problem in a different way, and a satisfactory one would be to construct the plates, if possible, so that the prime causes of trouble cannot arise, no matter what mistakes the attendant make or what emergencies the battery may be called upon to meet within reasonable limits. The chief evil effects are apparently caused by too rapid charging and discharging, and what should be done is to try and construct the plates so that they are adapted to high rates without a great loss of efficiency or capacity. The ideal method would seem to be a vertical lead plate to act as a good conductor, with an extremely large surface and a very thin layer of peroxide on it, freely exposed to a large quantity of acid, which is capable of circulating rapidly. That such a plate may

be made to have a far greater capacity per pound of plate for rapid discharges, and at least equal for slow discharges, as compared with the best thick, porous plate, has been shown by experience. The great capacity is doubtless due to the fact that the active material is more completely utilized, as it is all close to the conductor and freely exposed to the acid. The capacity of such a plate will evidently be effected only slightly by the rate, and the loss of voltage, and, therefore, the watt efficiency will depend more on the conductivity of the lead than on the acid becoming too dilute in the immediate neighborhood of the active material. To obtain high rates, accompanied by good efficiency and capacity, there is little doubt that the best way is to use large surfaces rather than to try to resist the evil effects of high rates mechanically.

In rapid charging the acid becomes too dense in the pores of a thick mass of active material if the circulation does not keep pace with the demand; this dense acid softens the peroxide, and there is a tendency to form gases when the proper chemical action cannot keep pace with the current. Both the softening and the mechanical effects of the gases are injurious. What was said regarding porosity and the ideal plate applies therefore also to the charging. The negative plates being soft and tough, are not so easily injured, but unless the acid can circulate very freely there will still be a lowering of the voltage like with the positive plates, and probably also a lowering of the ampere-hour capacity.

The contact between the peroxide and its conductor must be very good, for, if poor, then a white sulphate forms at the surface, which practically produces an insulating layer and disastrous effects are then inevitable. The ideal contact is obtained when the peroxide is formed on the lead electrolytically, as in the Planté processes.

The peroxide will insist on expanding during the discharge and on contracting during the charge. It would be much better to accept this as an inevitable fact than to try to keep the material from obeying the laws of nature by forcibly confining it within an inelastic frame. The best solution seems to be to have the active in the form of an extremely thin layer over a large surface and formed from the lead itself, as this increases its adhering properties. If such a layer can be made porous, and if the surface is made up of small facets, there will be little tendency to buckling or scaling.

The gradual washing away of the surface of the peroxide, and the slow peroxidation and consequent disintegration of the lead support, seem to be absolutely unavoidable,—but there is one way of meeting the difficulty which has recently been applied, and which seems to be a much more rational and effective solution of this vexed problem, at least when lightness and smaller first cost are desired. Instead of making the positive plates heavy and expensive, they may be made very light, cheap and easily replacable ; their life may then be shorter, but the battery will be as good as new whenever these perishable parts have been renewed ; their life is soon known to the user and he can readily then determine for himself how much he must allow for amortization. Such a method, to be successful, requires that the old plates and sludge be converted at a small cost into new plates ; this it seems can now be done, and Mr. Hering believes that this alone will have a very important bearing on the outlook of the storage battery, at least for portable cells, such as are required for traction and many other purposes, or for both portable and stationary plants if the first cost is an important factor. Such a method becomes practicable only when the chief factor in the cost of the plate is the material, the cost of labor and forming being small.

For stationary purposes, in which the only objection to the weight is the first cost of the lead, good storage batteries have been used abroad with success for some time, provided the rates of charge and discharge are kept low, but this is not true of batteries for accumulator traction, which Mr. Hering states is the ideal system, as has been repeatedly acknowledged by good authorities, and he considers it probable that this field for batteries is very large, and perhaps larger, than that for stationary work.

For this very trying work he believes the only batteries which have a promising outlook are those which have a very large surface, very small depth of active material formed electrolytically, and a very free circulation of the acid. The lead frames should be made only thick enough for proper conduction, the batteries must be cheap in first cost, and the positive plates should be capable of being replaced comparatively frequently at small cost. They should be proportioned so that a discharge corresponds to one trip of the car—and only one. To claim as an advantage that a battery can run a car, say four trips, is mere deception, and to the intelligent engineer it is simply an admission that it can do no better. No one would think of carrying four relays of horses on a trailer of a horse car, and why, he asks, should the equivalent be done with the storage battery unless it is that the battery can do no better and that it cannot be discharged rapidly enough so that the capacity and weight may be reduced to that required to run only one trip? The ideal Mr. Hering considers to be a single-trip discharge. If the rate for a four-trip battery could be increased four times without materially affecting the capacity, its weight and capacity for a single-trip discharge would evidently need be only one fourth as great. The charging rate should also be equal in hours to the mean discharge rate, or else it will take a plant of more than two sets of batteries to a car.

Mr. Hering summarized his discussion as follows : Cessation of litigation and the development of the Planté type of cells make the storage-battery outlook in this country much brighter ; the cost of a guarantee storage battery seems in many cases to be too nearly equal to that of the direct generators to encourage their general adoption. A reduction in the cost would therefore open a large field, much larger than in proportion to the reduction ; the renting of accumulators seems a commendable method for introducing them. Most of the diseases which storage batteries are subject to could be avoided or made much less disastrous by having large surfaces, small depth of active material and free circulation. The first cost would be reduced and the vexing question of the uncertain amortization settled, by a light, short-lived, cheap, positive plate and a cheap process of re-converting old into new positive plates. Storage batteries for slow discharges have been a success abroad ; a very large additional field would be opened by a light, cheap, rapid-rate cell.

The objection to a plate with a thin layer of active material is that it may not retain its charge as well as one with a thick layer or pellets, but in most cases in which rapid rates are desired, or cannot be avoided, the small loss in standing is probably more than balanced by the fact that the plates are not injured by rapid rates. As a rule, long periods between charges go hand in hand with slow discharges and less objection to great weight, while short periods between charges, high rates of discharges and lightness, usually go together.

In conclusion, Mr. Hering made the following recommendations in the interests of engineers who may have to calculate accumulator plants :

That rates of charge and discharge be designated in *hours* and fractions, the current (or for power purposes, the watts) during that time being considered to be kept constant. There can then be no mistake as to what is meant, as this represents the time in hours during which a cell will continue to give a practically constant current before the voltage falls below its limit. That efficiencies and capacities be always accompanied by the corresponding rate in hours. That in giving an efficiency it should always be stated whether it is for ampere-hours or watt-hours. That for portable batteries intended for power purposes the capacity be given in watt-hours instead of ampere-hours and that the weight given be that of the complete cell ready for use, as distinguished from the weight of the plates alone.

A short communication was next presented by Mr. Reckenzaun, who stated that owing to the fact of his absence in Europe, from which he had only just returned, he had not had sufficient time to prepare a more comprehensive paper.

THE DISCUSSION.

Mr. Wolcott expressed the opinion that Mr. Edgar's paper was exceedingly timely and important, in that it presented an account of what had actually been accomplished in practice, and did not theorize as to what might or might not be accomplished. Referring to Mr. Perry's figures on the consumption of gas by gas engines, Mr. Wolcott thought that 15 cubic feet per horse-power-hour was an exceedingly low figure, and expressed his doubts as to whether such results were possible. Mr. Perry replied that he had merely given 15 cubic feet as the figures which were claimed by some manufacturers, but thought that he had explicitly stated that in practice a figure of 17 or 18 cubic feet was the most economical so far obtained ; in figuring out the results given in his communication he had based his calculations upon the consumption of 25 cubic feet per horse-power-hour.

Mr. Edgar, referring to Prof. Crocker's proposed use of accumulators as transformers, charging them in series and discharging them in multiple, said that the objection to such practice was that the same mains could not be used for charging and discharging the accumulators, whereas if the accumulators were charged at about the potential of the lighting mains, the dynamos and accumulators could both be connected with the same mains at all times if desired. Concerning the comparative cost of accumulators and a regular gen-

erating plant, he stated that his company has just had installed accumulators at a cost of $50,000, of the same capacity as a steam and dynamo plant which would cost $65,000, its capacity being reckoned in kilowatts, of course, and the batteries had a guaranteed efficiency of 75 per cent. Referring to the matter of depreciation, Mr. Edgar stated that the European company which had furnished his accumulators guaranteed a depreciation not exceeding 6 per cent., and that the same company's practice in Germany was to make a 4 per cent. guarantee, of which 75 per cent. of its customers declined to avail themselves, because results showed that their depreciation did not exceed 3 per cent.

Mr. H. Ward Leonard called attention to the application of storage batteries for the regulation of the speed of motors used in elevator and kindred service. He regarded patent ligitation merely as an excuse, and expressed the opinion that the reason storage batteries had not come to the front more rapidly in this country was that no meritorious battery had hitherto been produced. He stated that he had installed a great many dynamos and a considerable number of accumulators during the past ten years, and while all of the dynamos installed were still in use and giving good service, not one of the storage-battery plants had survived. "This may be because I put them in," he added. (Laughter). Referring to the comparative cost of a storage battery and a steam and dynamo plant, he thought that in making such comparisons, the cost per kilowatt capacity of an engine should be based upon the *maximum* safe capacity of that engine, and not upon its rated capacity. He said that he did not agree with Mr. Edgar that a storage-battery plant was cheaper than a steam and dynamo plant of the same capacity in watts. He had never been able to buy batteries at less than $180 per kilowatt capacity, operated at their guaranteed rate, and even Mr. Edgar's figure of $120 per kilowatt capacity, was not cheaper than a steam and dynamo plant. Mr. Edgar replied that the element of overload for storage batteries was about equal to that of a steam and dynamo plant, and that the cost per kilowatt capacity of the former was based on about the same load as for the latter.

Mr. Entz, referring to the matter of depreciation, said that for the last year he had been in and around the Tudor factory in Germany, and that all the engineers he met in that country agreed with Mr. Edgar as to depreciation. He said that the practice of the company manufacturing the Tudor battery was to guarantee a battery irrespective of its discharge rate, and that it had made money on its 4 per cent. guarantee.

Mr. Blizard expressed the belief that it was impracticable to operate gas engines driving large dynamos connected in parallel, which would be necessary in order to take care of the peak of the load with gas engines in a large station, as proposed by Mr. Perry. He also stated that American gas engines very nearly approximated the efficiency of those of foreign makes, and referring to Mr. Perry's statement as to the extensive use of the gas engine in European central stations, he called attention to the fact that there were very few of those stations which did not use accumulators in connection with the gas engines. He expressed the opinion that previous storage-battery practice had been wrong, in that manufacturers had not considered the specific conditions under which batteries were to be used.

Mr. E. T. Birdsall thought that the trouble with storage batteries had been that the batteries so far installed were invariably too small for the work to be performed, and stated that he had recently displaced a plant of 300 ampere-hours capacity with one of 800 ampere-hours capacity, which was not made larger because that was the biggest one his customer would buy. If he had had his way, he said, he would have made it a 1600 ampere-plant.

Mr. Appleton criticised Mr. Perry's proposition of running gas mains to an annex station for the operation of engines at that point, and thought that as the copper conductors were there anyhow for distribution purposes, they might as well be used for transmitting current to the sub-station. Mr. Perry replied that the object in using the gas mains was to render unnecessary the copper conductors, and that it was not his proposition to have both gas pipes and copper wires extending from the main station to the sub-station.

Mr. Childs criticised Mr. Hering's suggestion that the best practice for railway work would be to have a car equipped with a battery which would only last through one trip, and asked Mr. Hering what he meant by one trip. Mr. Hering replied that one trip was the work of a car from the time it left the power house until it got back again, and said that he thought that this was so obvious that it needed no explanation. Mr. Hering again called attention to the fact that there was much confusion in the rating of accumulators, and thought that when prices and capacities were given the discharge rates should invariably be stated also.

Mr. Lieb took exception to Mr. Hering's statement that one of the troubles of the storage battery was that it had been left too much in the hands of mechanical engineers, and had not received sufficient attention from competent chemists. Mr. Lieb thought that what success the storage battery had so far attained was almost entirely due to the work which had been put upon it by mechanical engineers.

Owing to the lateness of the hour, the discussion was here declared closed, and the meeting adjourned.

Armature Winding and Connecting Considered as a Mathematical Problem—II.

BY HARRISON H. WOOD.

In winding a drum armature there is, as has been shown in the previous portion of this article, no fixed law governing the placing of the coils. The spacing must be near to the value S/p, but may vary somewhat from that value; but after it has been decided for one coil it has been decided for all; and after one coil has been placed the others follow in simple order. The coils are usually all placed in position before the commutator is put on and connections to it commenced. In connecting to the commutator a fixed law must be followed. This law gives the number of bars by which the two ends of a coil must be separated, and, while in some cases there may be two values for this number, there are never more than two and usually only one, and this number, or the quantity which has been termed the "spacing on the commutator," and represented by y, can be found in terms of the number of bars, coils and grooves. Of course it will be necessary before beginning to connect to be able to distinguish the two ends of a coil, which may be done by marking the two ends in some manner. For the purposes of this article it will be assumed that the two ends of any coil are always known.

CONNECTING THE COILS TO THE COMMUTATOR.

It was stated that in counting around the armature and the commutator to locate the spacing and the connections of the halves of a coil the counting was always to proceed to the right, as viewed from the commutator end, and that the left-hand half was to be carried direct to the commutator. Since there are two circuits or paths into the armature from each bar, the one that leads direct to the armature and around to the right is the one always referred to. If this circuit be followed around through the armature it will return to the next adjacent bar either on the right, as in Figs. 2 and 3, or on the left, as in Fig. 1. Figs. 8 and 9 illustrate lap and wave windings respectively,

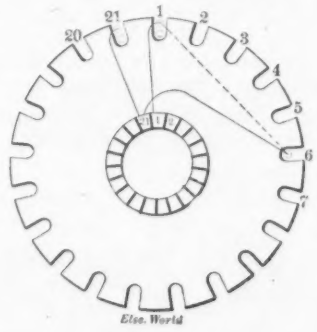


FIG. 8.

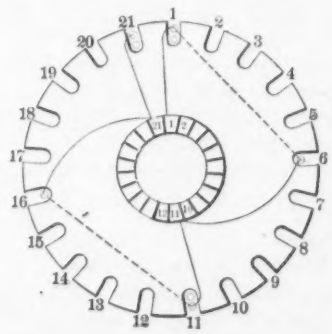


FIG. 9.

in which the circuit returns to the next adjacent bar on the left. The former—illustrated in Figs. 2 and 3—might be designated *right-hand* winding and the latter—illustrated in Figs. 1, 8 and 9—*left-hand*, but, unfortunately, the term *right-hand* is used to designate a winding where, with positive rotation in a field with the north pole on the left, as in Fig. 1, the positive brush is produced at the top. This definition is properly applicable to two-pole machines only, and where the connections are such as to bring the brushes between the poles; hence it is arbitrary, and in no sense describes the winding. Therefore, to avoid confusion with this term, the algebraic symbols + and — will be used, and their appropriateness will be seen from the formula that will be derived for determining the value of y. A + winding is one where the circuit returns to the next bar on the right, a — winding where it returns to the next bar on the left.

In lap windings the two ends of a coil are always connected to adjacent bars, except where there are two or more independent windings; therefore they need not be considered here. In the case of wave windings, as shown in Fig. 2, it is evident that the two ends of a coil must be so connected to the commutator that the cir-

cuit starting from any one bar will pass beneath all of the poles before it returns to the next adjacent bar. In Fig. 2 the circuit beginning at bar 1 goes through grooves 1 and 4 to bar 7, and thence through grooves 7 and 10 to bar 2, passing across the armature as many times as there are poles in the field. The spacing between the two ends of a coil must be the same in all cases, for if it were not some ends would have no bars to be connected to, and some bars would be left without connections. The spacing between the ends of the coils in Fig. 2 is 6, the number of bars is 11, hence $y = \frac{1}{2}(11+1)$ or $\frac{1}{2}(b+1)$. Fig. 9 illustrates a winding where $y = 10$, or $\frac{1}{2}(b-1)$. In general, the spacing for four-pole armatures will have to be either $\frac{1}{2}(b+1)$ or $\frac{1}{2}(b-1)$, and may be written:

$$y = \frac{b \pm 1}{2}.$$

When the + sign is used, the winding will be what we have designated as a "+" winding, as in Fig. 2, where $y = \frac{1}{2}(11+1)$. When the — sign is used, the winding will be a "—" winding, as in Fig. 9, where $y = \frac{1}{2}(21-1)$.

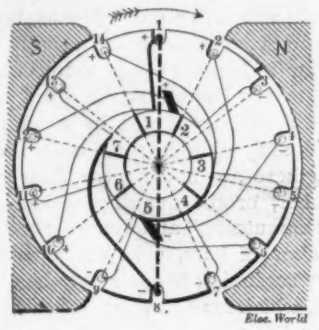


Fig. 1.

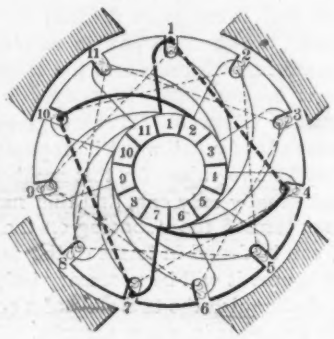


Fig. 2.

If there are six poles the circuit must return to the commutator three times before passing completely around the armature, and the spacing will have to be $\frac{1}{3}(b+1)$ or $\frac{1}{3}(b-1)$, or the equation for y will be

$$y = \frac{b \pm 1}{3}.$$

The reasoning is the same for any number of poles, and the formula for the general case of p poles will be

$$y = \frac{b \pm 1}{\frac{1}{2}p},$$

and since $b = \frac{1}{2}c$

$$y = \frac{c \pm 2}{p}.$$

In the illustration so far given no more than two conductors or half-coils have been placed in a groove. The formula, however, applies to windings with any number of half-coils per groove, as it is dependent only on the total number of coils on the armature. It will be more useful in the form

$$y = \frac{r\,S \pm 2}{p},$$

where $r\,S$ is substituted for c.

Illustration: Suppose in a six-pole machine the armature is to have 127 grooves or sections with two half-coils per groove. $S = 127$, $r = 2$, and $p = 6$, and we have

$$y = \frac{2 \times 127 \pm 2}{6} = 42\tfrac{2}{3} \text{ or } 42,$$

according as the + or — sign is used. But y must be an integer; hence the only possible winding in this case will be with the spacing $y = 42$, and the two ends of the first coil will be connected to bars 1 and 43. Since the — sign must be used to obtain the integral value of y, the winding will be — and the circuit will return to the next adjacent bar on the left, as in Fig. 9.

Since y must be an integer, there will be certain values of S that will make winding impossible. For instance, if $r = 2$ and $p = 4$,

$$y = \frac{2\,S \pm 2}{4},$$

from which it will be seen that S must be an odd number to make a possible winding.

If $p = 6$, and $r = 2$

$$y = \frac{S \pm 1}{3},$$

and S will have to be any number not a multiple of 3. If S is one more than a multiple of three, only a — winding will be possible, and if it is one less, only a + will be possible.

The possible values of S corresponding to the different values of p and r can be found from the formula by inspection, and have been so found and classified in the accompanying table for values of p up to 12 and of r up to 8.

It will be noticed in this table that for odd values of r connections to the commutator are possible in every case only for even values of S. Hence the conditions laid down for possible placing of the coils on the armature for odd values of r are covered in this table and need not be further considered.

If the designer has determined on the number of grooves on the armature and the number of coils to be placed in each, he can see from the table whether the winding is possible, and from the formula can determine what the spacing on the commutator will be. If the winding is impossible the number of grooves must be altered so as to produce a possible one.

Illustration: On a 10-pole armature it is desired to put four coils in groove, and the total number of half-coils must be about 540. This will require 135 grooves. From the table it will be seen that for $p = 10$ and $r = 4$, S must be a multiple of 5, + 2: hence we will have to make S 133 or 137. If S is 133,

$$y = \frac{4 \times 133 \times 2}{10}, = 53\tfrac{1}{10}$$

when the + sign is used and 53 when the — sign is used. Hence the spacing will be 53 and the winding —.

If $S = 137$,

$$y = \frac{4 \times 137 \times 2}{10} = 55$$

when the + sign is used and $54\frac{1}{10}$ when the — sign is used. Hence the spacing will be 55, and the winding +.

It will be seen from the table that there are some cases where no winding whatever is possible. A four-pole machine cannot be wound with four conductors per groove, for the value of y in this case is $S \pm \frac{1}{2}$, which is never integral. The only way in which such an armature can be wound is to cut off the ends of one coil, making what may be termed a "dead coil," not included in the armature circuit. This is practically doing away with half a groove, and therefore making S fractional and the value of $S \pm \frac{1}{2}$ integral. The same is true where $p = 6$ and $r = 6$, making $y = S \pm \frac{1}{3}$. Here the winding can be made possible by cutting out one coil or one third of a groove, making the + winding possible, or by cutting out two coils or two thirds of a groove, making the — winding possible.

The same may be done in all cases marked "impossible" in the table, but the windings produced are imperfect from a mathematical point of view, and cannot be included in any general classification.

	$p=2$	4	6	8	10	12
$r=1$	Any even number.	Odd multiples of 2.	Any multiple of 2 not a multiple of 3.	Odd multiples of 2.	Multiples of 10, ± 2.	Multiples of 12, ± 2.
2	Any number.	Any odd number.	Any number not a multiple of 3.	Any odd number.	Multiples of 5, ± 1.	Multiples of 6, ± 1.
3	Any even number.	Odd multiples of 2.	Impossible.	Odd multiples of 2.	Multiples of 10, ± 4.	Impossible.
4	Any number.	Impossible.	Any number not a multiple of 3.	Impossible.	Multiples of 5, ± 2.	Impossible.
5	Any even number.	Odd multiples of 2.	Any multiple of 2 not a multiple of 3.	Odd multiples of 2.	Impossible.	Multiples of 12, ± 2.
6	Any number.	Any odd number.	Impossible.	Any odd number.	Multiples of 5, ± 2.	Impossible.
7	Any even number.	Odd multiples of 2.	Any multiple of 2 not a multiple of 3.	Odd multiples of 2.	Multiples of 10, ± 4.	Multiples of 12, ± 2.
8	Any number.	Impossible.	Any number not a multiple of 3.	Impossible.	Multiples of 5, ± 1.	Impossible.

Table showing values of S that will give integral values to y in the equation $y = \frac{r\,S \pm 2}{p}$.

The Invention of the Electromagnetic Telegraph—VIII.*

BY MARY A. HENRY.

The telegraph was impracticable on account of the failure of the electrical force with the extension of the galvanic circuit. Barlow published his discouraging verdict in 1824; two years later, in 1826, Prof. Dana was lecturing in New York on the new science of electro magnetism. Upon his table was a copy of Sturgeon's magnet. This, as described by Sturgeon in 1825, consisted of a small bar of soft iron, bent into the form of a horseshoe, having a copper wire wound loosely around it in eighteen turns, with the ends of the wire dipping into mercury cups connected with the respective poles of a battery, having 130 square inches of active surface. With all this large battery it could lift only a few pounds. Doing so little, with such great expenditure of galvanic power, this instrument destined later—when developed by other hands than Sturgeon's—to hold such an eminent place in the affairs of man, was as yet only an infant and of no use in the arts; but it was a very curious and interesting object, for it was the first electromagnet and exhibited the newly discovered electrical phenomena, then almost unknown in America. There were two men listening to that lecture with especial interest—Prof. Morse and Henry, a mere youth on a visit to the city. After the lecture Prof. Morse went over the sea, to study art in foreign lands; Henry, with his mind intent upon the experiments he had witnessed, full of enthusiasm, returned to Albany, and to the academy where his busy days were passed. He made a copy of Sturgeon's magnet that he might study it. The 18 turns of the wire were far apart on the iron bar in order that the electrical current might not leap from one turn to the other, instead of running its destined course, through the whole extent of the galvanic circuit. Henry looked at the loose coil and thought of the theory of Ampere, that the magnetization of a bar of steel consists in establishing within the metal, by induction, a series of electrical currents—like rings—all revolving in the same direction, at right angles to the axis or length of the bar; he concluded at once that the spiral of wire conducting the galvanic current around the iron bar of the electromagnet should approach as nearly as possible to rings at right angles to the bar. His first step was to insulate the wire, and then he was able to wind it in a compact coil, in close juxtaposition, from one end of the magnet horseshoe to the other, increasing thus not only the number of circuits, but bringing each circuit more nearly at right angles to the magnetic axis. Magnets on this principle were exhibited by Henry to the Albany Institute in 1828 and 1829 exhibiting great lifting power. Not content with this near approach to the rings of Ampere, and troubled still by the bend of the spiral from the desired right angle, Henry at last thought of obviating this difficulty by winding a second spiral over the first, "with the pitch of the screw,

FIG. 1.—"QUANTITY" MAGNET.

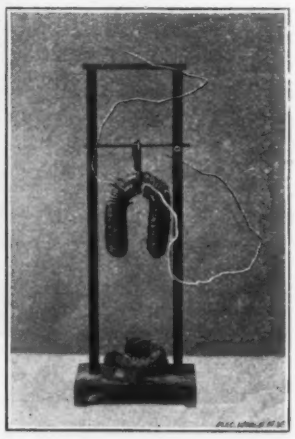


FIG. 2.—"INTENSITY" MAGNET.

so to speak, in the opposite direction," so that the resultant of the two currents, from the two spirals, was the same as if one current revolved at right angles to the core. In this way he multiplied the coils to an enormous extent. Mr. Taylor says: "To Henry therefore belongs the exclusive credit of having constructed the magnetic 'spool' or 'bobbin,' that form of coil since universally employed for every application of electromagnetism, of induction, or of magnetic electrics. . . . By means of the Henry 'spool' the magnet almost at a bound was developed from a feeble childhood to a vigorous manhood." "And so rapidly and generally was the new form introduced abroad among experimenters,—few of whom had ever seen the papers of Henry—that probably very few indeed are aware to whom they were really indebted for this familiar instrumentality."

"But in addition to this large gift to science, Henry has the pre-eminent claim to popular gratitude of having practically worked out the differing functions of two entirely different kinds of electromagnets."† He found that by winding the iron bar with a number of separate coils of short, thick wire he had formed another magnet of very different qualities and much greater force. This he called the "quantity magnet" because it was excited by a battery of a single pair of plates called a quantity battery, while he called the magnet with the long, fine coil of wire, the "intensity magnet" because responsive to a battery of numerous elements, called an intensity battery. In making this connection between battery and magnet, he made a great discovery; that the intensity magnet, if feebler, had the singular capability of subtle excitation from a distance source. Then the magnets of the telegraph were ready.

What was the law which connected the two magnets with their respective batteries? It was that very law, want of knowledge of

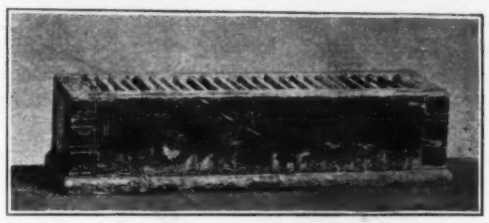


FIG. 3.—TROUGH BATTERY.

which had rendered impracticable the telegraph. How did Henry discover it? One day—surely this is a very eventful day in the history of the telegraph—Henry made a new series of experiments. Up to this day his efforts with his magnets had been confined to producing the greatest lifting effect with the smallest amount of battery power; his experiments had mostly been made with two very small plates. On this day he was to try batteries of different sizes, and wires of different lengths. One long wire was suspended many times around the room in which the experiments were made—a large room, 40 feet in length, used for the public exercises of the academy. Henry had made for his experiments a number of batteries of different sizes, large and small, but each with only a single pair of plates. Among these stood a small compound battery, a Cruikshank's battery, in a small trough. (This little battery now stands in the National Museum of Washington.) The experiments are recorded in a paper published in *Silliman's Journal*, Jan. 1, 1831. We may not follow them in detail. They began with those batteries of different sizes, but of a single pair of plates. In imagination we can see Henry taking them up one by one, now large, now small, trying how much his magnets can lift and through what extent of wire, as he approaches the experiment which is to render possible the telegraph. At last, he takes up the little trough—the compound battery.

At first he tries it in close proximity to a magnet, but with no satisfactory result. Then he places it in the circuit of that long wire, wound many times around the large room. In that circuit is an intensity magnet. Henry closes the circuit and immediately the sensitive magnet responds through all that length of wire. The "intensity" magnet and the "intensity" battery are for the first time in communication, and acknowledge their mutual relation; the problem of the telegraph is solved; the old difficulty of the failure of the electrical force will no longer oppose its stubborn wall to the progress of the telegraph. Henry sees immediately the bearing of his discovery upon the telegraph. He recognizes also immediately the cause of the phenomenon; namely, the projectile power of the compound battery in proportional correspondence with the resistance in the long, slender wire of the magnet, and he shows that he understands it, by immediately connecting his quantity magnet with a quantity battery of a single pair of plates. He says:† "The fact that the magnetic action of a current from a trough is not sensibly diminished by passing through a long wire, is directly applicable to Dr. Barlow's project of forming an electromagnetic telegraph, and it is also of material consequence in the construction of the galvanic coil. From these experiments it is evident that in forming the coil we

*Continued from page 573.

†Taylor: *Henry and the Telegraph.*

may either use one very long wire, or several shorter ones, as the circumstances may require ; in the first case, our galvanic combination must consist of a number of plates, so as to give projectile force ; in the second, it must be formed of a single pair." What Henry accomplished on this eventful day was to marry the intensity magnet to the intensity battery, the quantity magnet to the quantity battery, and they have never been divorced.

Mr. Taylor says : "Never let it be forgotten that he who first exalted the magnet of Sturgeon . . . was the absolute CREATOR of the 'intensity' magnet ; that magnet which alone is able to act at a great distance from its exciting battery ;—that magnet which, by the very reason of its lower quantity, 'is alone applicable to the uses of telegraphy.' I would add, nor should it be forgotten that he who created the magnet discovered the law, equally indispensable to the telegraph, of the projectile force and proportional resistance which bound magnet and battery together." It takes nothing from Henry's discovery that Ohm had published, in 1827, a mathematical theory of this same law. This theory was unknown, and did not effect science in England, France and America until much later. It was unknown to Faraday in 1837, to Bain in 1845. Henry did not find it until 1837.

To illustrate the law he had discovered for the benefit of his pupils, Henry constructed the familiar apparatus which has been repeatedly mentioned in this discussion. This is his account of it: "I arranged around one of the upper rooms in the Albany Academy a wire of more than a mile in length, through which I was enabled to make signals by sounding a bell. The mechanical arrangement for effecting this object was simply a steel bar, permanently magnetized, of

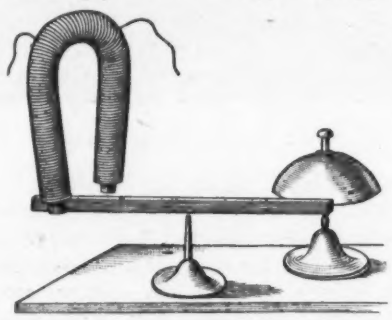


Fig. 4.—Bell Ringing Arrangement.

about 10 inches in length, supported on a pivot, and placed with its north end between the two arms of a horseshoe magnet. When the latter was excited by the current, the end of the bar thus placed was attracted by one arm of the horseshoe and repelled by the other, and was thus caused to move in a horizontal plane and its further extremity to strike a bell, suitably adjusted."

This simple device Henry exhibited to his classes during the years 1830, 1831, and 1832, to illustrate how easily signals might be transmitted to a distance by the action of electromagnetism.

A third of a century later, on the celebration of the semi-centennial anniversary of the Albany Institute, June 23, 1863, Dr. Orlando Meads, who was one of the boys in those classes, thus speaks of it: "The older students of the Academy in the years 1830, 1831 and 1832, and others who witnessed his experiments, will remember the long coils of wire which ran, circuit upon circuit, for more than a mile in length, around one of the upper rooms of the Academy for the purpose of illustrating the fact that a galvanic current could be transmitted through its whole length, so as to excite a magnet at the further end of the line, and thus move a steel bar which struck a bell."

Prof. James Hall, the distinguished geologist, Jan. 19, 1856, when president of the American Association, at its Albany meeting, in a letter to Henry dated Jan. 19, 1856, gives the following reminiscence:

"While a student of the Rensselaer School in Troy (N. Y.) in August, 1832, I visited Albany with a friend, having a letter of introduction to you from Prof. Eaton. Our principal object was to see your electromagnetic apparatus, of which we had heard much.

"You showed us your laboratory in a lower story or basement of the building, and in a larger room, in the upper story, some electric and galvanic apparatus, with various philosophical instruments. In this room, and extending around the same, was a circuit of wire, stretched along the wall, and at one termination of this, in the recess of a window, a bell was fixed, while the other extremity was connected with a galvanic apparatus. You showed us the manner in which the bell could be made to ring by a current of electricity transmitted through this wire, and you remarked that this method might be adopted for giving signals by the ringing of a bell at the distance of many miles from the point of its connection with the galvanic apparatus. All the circumstances attending this visit to Albany are fresh in my recollection ; and during the past years, while so much has been said respecting the invention of electric telegraphs, I have often had occasion to mention the exhibition of your electric telegraph in the Albany Academy in 1832."

Mr. Taylor says "this memorable experimental telegraphic arrangement involved three very significant and important novelties." In the first place it was the first electromagnetic telegraph arrangement employing an "intensity" magnet capable of being excited at a very great distance. And there can be no doubt that a similar combination of "intensity" battery, with a very long coil galvanometer had previously been found inoperative, and was alone wanting, to have rendered the early telegraph of Shilling a popular and commercial success.

In the second place this experimental arrangement of Henry was the first electromagnetic telegraph employing the armature as a signaling device, or employing the *attractive* power of the intermittent magnet, as distinguished from the *directive* action of the galvanic circuit—that is to say it was, strictly speaking, the first "*magnetic* telegraph."

In the third place, it was the first *acoustic* electromagnetic telegraph. . . .

These clear and positive statements may be summed up in one sentence. It was the first successful telegraph, the first telegraph which could be extended indefinitely without failure of the electric force, for it was the first telegraph constructed in accordance with principles which time has proved to be unfailing. Some one in these articles has said Gauss's and Weber's was the first telegraph of any length. When stretched over the houses of the town, connecting observatory with observatory, was it any longer than Henry's? But it matters little if it were or were not longer. Henry's telegraph was constructed upon principles which rendered it indifferent to length ; that mile of wire around his room represented the thousands to which it has since extended. It has been said Henry's arrangement was not a telegraph, that it was only an experiment. If only an experiment it is one which is still being tried most successfully and allows each of you, my readers, to have your message. Look at the instrument in use in the telegraphic offices of to-day! An electro-intensity magnet, in connection with an intensity battery, when excited attracts a vibrating armature, which hits a sounder

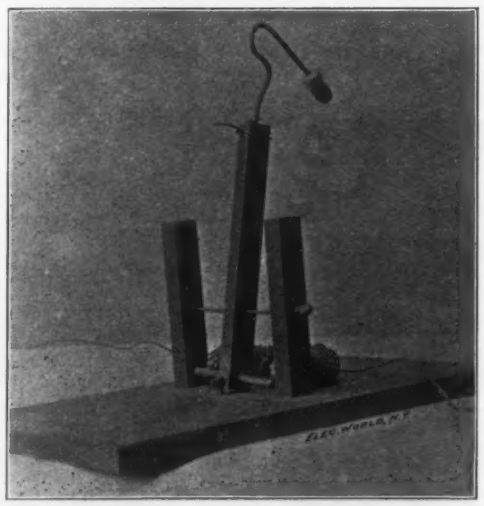


Fig. 5.—Electric Hammer.

If the telegraph of Gauss and Weber, used at first only for scientific purposes, can be so called a telegraph, so should Henry's be. When does a telegraph begin to be a telegraph? But what's in a name?

In 1832 Henry went to Princeton. To illustrate there the principle of telegraphy, he stretched wires from his laboratory in the college philosophical hall to his dwelling house, and communicated, in the presence of his class, with Mrs. Henry, on the other side of the college grounds. In these experiments a metal triangle was sometimes used instead of the bell. A piece of apparatus among the articles preserved in Princeton, consisting of a little hammer hung in a frame, the lower end of which might easily be attracted by a magnet so as to drive forward the hammer above, must, I think, have been used to sound this triangle. (See Fig. 5.)

It seems that it was in Princeton that Henry made still another great contribution to the telegraph. It was late in December, in the year 1832, that he went to Princeton. In what was really his first year there (1833) he constructed for the laboratory a powerful quantity magnet, which is still preserved in Princeton. It far surpassed a very powerful one he had made for Yale College, before leaving Albany, its lifting power, with a battery not exceeding one cubic foot in bulk, being 3500 pounds. Henry had established fully the fact that the intensity combination of magnet and battery was capable of action through an extended circuit. He had equally established the fact that his quantity combination, while incapable of such distant action, was much more powerful. The ingenious idea occurred to him that he might make one circuit open the other, so that the sensitive intensity magnet, when excited by distant influence, might call into play the more powerful quantity magnet, and that in this way not only telegraphic signals but great mechanical effects might be produced at a distance. It was simply necessary for this purpose to apply to the oscillating armature of the intensity magnet a suitable prolongation, so arranged as to open and close the short circuit of the adjoining quantity magnet. He tried the experiment with his new great magnet, breaking its circuit by the mere lifting of a small wire from a mercury thimble, and causing it to drop heavy weights. One mode of exhibiting the experiment was to suspend from the armature of the magnet a platform, upon which was crowded a number of college youths, and Mrs. Henry, opening or closing the intensity circuit from the dwelling house on the opposite side of the college grounds, made the magnet lift and drop its living load, much to the amusement of the class. It seemed like magic. It is interesting to give Henry's own description of this device, especially as it shows that when he went to Europe in 1837 it was an old story with him. Wheatstone was then engaged with his telegraph. He had discarded the electromagnet as a sound signal because he had found sufficient attractive power could not be imparted to it in a long circuit, and he had substituted for it a secondary galvanic circuit. It was this circuit which attracted Henry's attention, as he stood with Wheatstone over the telegraph and called out a description of his somewhat similar device.

"In February, 1837, I went to Europe, and early in April of that year Prof. Wheatstone, of London, in the course of a visit to him in Kings College, London, with Prof. Bache, now of the Coast Survey, explained to us his plans of an electromagnetic telegraph, and among other things exhibited to us his methods of bringing into action a second galvanic circuit. I informed him that I had devised another method of producing effects somewhat similar. This consisted in opening the circuit of my large quantity magnet at Princeton, when loaded with many hundred pounds weight, by attracting upward a small piece of movable wire, with a small intensity magnet, connected with a long wire circuit. . . . When the circuit of the large battery was thus broken, by an action from a distance, the weights would fall, and great mechanical effects could thus be produced, such as the ringing of church bells at a distance of 100 miles or more, an illustration I had previously given to my class at Princeton. My impression is strong that I had explained the precise processto my class before I went to Europe, but testifying now, without the opportunity of reference to my notes, I cannot speak positively; I am certain, however, of having mentioned in my lectures every year previously at Princeton the project of ringing bells at a distance by the use of the electromagnet, and of having frequently illustrated the principle of transmitting power to a distance to my class, *by causing in some cases a thousand pounds to fall to the ground on the floor, by merely lifting a piece of wire from two cups of mercury closing the circuit.*

"The object of Prof. Wheatstone in bringing into action a second circuit was to provide a remedy for the diminution of force in a long circuit. My object in the process described by me was to bring into operation a large quantity magnet, connected with a quantity battery in a local circuit by means of a small intensity battery magnet and an intensity battery at a distance."

When Henry had accomplished this, the problem of the telegraph was entirely solved, and in this state he left it to those who could apply practically his discoveries to the commercial uses of man. He says: "My whole attention, exclusive of my duties to the college, was devoted to original investigations, and I left to others, what I considered in a scientific point of view of subordinate importance, the application of my discoveries to useful purposes in the arts."

To the practicable operation of the telegraph the construction of the constant battery by Daniell, in 1836, was of great importance. Henry, on his return from Europe, substituted this for a great battery he had made to use with his large magnet, but it must be remembered that this new battery, although more convenient, had to obey the same law of intensity and quantity. In 1837 Steinheil discovered the practicability of using the earth to complete a galvanic circuit. Henry was the first to repeat this experiment in America. He says: "I stretched a wire from my study to my laboratory, through a distance in the air of several hundred yards, and used the earth as a return conductor, with a very minute battery, the negative element of which was a common pin such as is used in a dress, and the positive element the point of a zinc wire immersed in a single drop of acid. With this arrangement a needle was deflected in my laboratory before my class."

Look now at the galvanic combination with which I began my article. How complete Henry has made it before the close of 1836; in fact, as early as 1833. His two magnets are in it with their different properties, and their different circuits, and he has made one circuit call into action the other, while the law has been discovered by which the circuit of the one magnet may be indefinitely extended and the power of the other as indefinitely increased. The *means of producing mechanical action at a distance* that was Henry's gift, and he had illustrated how it could be used in transmitting the messages of the telegraph, and also in other ways where powerful mechanical effects might be required. What then was left to discover or invent in regard to the telegraph? There was great room for invention in the local machines, which might be brought into the galvanic combination to be worked by it, at a distance. Henry's bar, hitting a bell, was a lever to which it was found might be attached a point or a pencil, to mark dots and lines on a slip of paper, and later a machine printed the electric message in the old familiar letters of our alphabet. Time has preferred the blow of the lever, and Henry's simple process gives to-day the sound of the telegraph.

(To be continued.)

Electric Annealing.

Mr. Herman Lemp, in a communication in the current number of the *Transactions* of the American Institute of Electrical Engineers gives the result of some experiments recently made, in order to more completely answer some questions asked when his paper on "Electric Annealing" was read before the Institute:

An annealing transformer was set upon a block of 18-inch Harvey plate, with a distance between the tips of contacts of 2¼ inches, and a current of 90 amperes allowed to pass through the primary for approximately half an hour.

Inasmuch as the resistance of the contacts to be measured causes considerable heating of the contacts, and this heat is carried away by the water cooling, this water cooling was made the means for determining the approximate resistance of the contacts. The water, which was allowed to circulate through the contacts, was carefully measured for temperature before it entered and when it left; and in this manner thermal units determined, which were lost through the contact resistance.

While it is true that not all the heat is properly attributable to the contact proper, and some of it is to be charged to the radiation from the heated surface, still this item is nearly enough balanced by the loss of heat of the contacts proper. The energy put into heating the water will therefore be a fairly good estimate of the heat caused by the contact.

The following data were obtained:

Current in primary.....	90 amperes
E. M. F. " "	200 volts
Energy as measured by wattmeter.....	15,698 watts

8.4 pounds of water passing through the contacts per minute were raised from 17° to 33°. From the above, total thermal units, 241.9, or a loss of 5.7 hp in both contacts. This was equivalent to 4352 watts for both contacts, or 2176 for one, and the current passing through the secondary being 9000 amperes, the resistance of one of the contacts is equal to .000026 ohm.

After the completion of the experiment contacts were carefully inspected, and it was found that a circle of approximately ¾ inches had been in actual contact with the armor plate, which with the current density of 9000 amperes would give a density of 19,550 amperes per square inch. While this is not as dense as intimated in the paper, it represents the normal condition, whereas 40,000 is a condition which occasionally happens, without, however, any injurious effects.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Compounding of Dynamos by Armature Reaction.—Prof. Thomson, in the Lond. "Elec. Rev.," Nov. 8, replies to the recent letter of Mr. Sayers (see Digest, Nov. 2). He fully appreciates the effects of armature reaction in breaking down the wound field poles and in producing even an opposing E. M. F.; he does not accept Sayers's extension of the curve, and thinks that by properly extending it, it would have shown the effects of the differential field resulting from the armature M. M. F. overcoming the field M. M. F. Regarding the effect of moving the brushes backward, he states that the experiment was tried on a number of occasions, and that invariably the same effect was observed; even with copper brushes there was but a moderate increase of the sparking; he suggests the hypothesis that in some way the distribution of the field was altered by each variation of the position of the brushes, in such a way as to give a fairly good commutation at the changed positions, but he admits that this hypothesis is not a satisfactory explanation.

Brushes.—The "Elek. Anz.," Nov. 3, illustrates a carbon brush which contains a number of longitudinal holes throughout its mass, these holes being filled with a lubricating material consisting partially of wax and stearine, whose melting point is 60 degrees C., and which at ordinary temperature is quite hard; occasional holes are left open for ventilating purposes.

Theory of Non-Synchronous Three-Phase Motors.—Mr. Rothert, in the "Elek. Zeit.," Nov. 7, gives a simple and easily understood theory of such motors, accompanied by simple diagrams.

LIGHTS AND LIGHTING.

The Arc Light.—Prof. Thompson's Cantor lecture (see Digest, last week) is continued in the Lond. "Elec. Rev.," Nov. 8; it is an interesting summary of what is known about the arc; only some of the more prominent points can be mentioned here. In discussing the physical nature of the arc he states that the temperature and brightness of the crater are the same for small or large arcs, and that this constancy is due to the fact that the carbon is vaporized at the surface and that this temperature of vaporization is constant; Despretz noticed that carbon becomes soft before volatization, which leads the lecturer to believe that there is a film of liquid carbon on the surface of the crater. The hissing arc he compares to the hissing which takes place in water just when it is beginning to boil; if more than a certain quantity of heat is made to pass off per sq. in. of surface of the water there will be a noisy phenomena, and he considers this analagous to that occurring in the hissing arc. He discusses the location of the back E. M. F., and gives reasons why he does not think the true explanation of the fixed voltage of an arc is due to a transitional resistance; whenever work is done by a current it is always done by virtue of a back E. M. F.; he explains experiments in which the fall of voltage from one carbon to the other was measured by means of a third small carbon introduced into the arc as an explorer. Such a test showed that there was a drop of about 39 volts at the crater and two or three volts at the negative peak, and the remainder of the 45 volts in the arc itself; some observers found a rise at the negative end. He shows the absurdity of Jamin's reasoning, that, owing to this back E. M. F., an alternating-arc would be much more efficient than a constant-current arc. Recent experiments of Prof. Blondel, who photographed the arc, proved that there is only one direction in which the material is ever transported, and that is from the positive to the negative. He showed an alternating-current arc of 2000 volts in which the whole arc was more or less luminous and in which very little carbon was transported; the higher the voltage the less the carbon consumed (he does not state that the consumption of the carbon is proportional to the current); some of the luminous phenomena obtained with high voltage are of the nature of a flame which takes heat from the current, and are therefore not like those in a true arc. Regarding the chemistry of the arc he believes it has never been thoroughly worked out; Prof. Dewar shows that carbonic acid, carbonic oxide, nitrogen compounds, prussic acid, cyanogen, nitrous acid and various other compounds are formed; the odor of the arc is probably due to combinations of carbon with nitrogen and oxygen, but a normal arc produces very little of this. In speaking of the magnetic properties of the arc he states that in an alternating arc the arcs are curved right and left, which is due to the effect of the earth's magnetism; to burn the arc steadily in a strong magnetic field is almost impossible. Non-arcing metals are discussed, and it is thought that it is not known why this effect occurs with certain alloys and not with others. In regard to the temperature of the arc he states that we may attribute a fairly reasonable accuracy of Violle's number, namely, 3500 degrees C., as the temperature of the crater; for the negative carbon he obtained about 2700, and he believes that the arc itself is probably hotter than either of the carbons; this may be shown by an arc between two zinc terminals, whose crater temperature would be that of the volatization of zinc; by introducing a less fusible material into the arc one can then find, with the aid of a spectroscope, whether it is hotter or not; he also showed that the amount of light per sq. mm of crater surface, and therefore the intrinsic brightness, was the same for small and large arcs. The effect of the conductivity of the carbons is discussed and the importance of good conductivity pointed out; that the resistance of good moulded carbons as now used is 0.1 to 0.2 ohm per foot; covering them with copper reduces these values ten to twenty-fold; he discusses the effects of surrounding gases on the arc; some experiments showed that chlorine, coal gas, hydrogen, nitrogen, etc., did not make one volt difference in the arc, but the shape of the crater and the peak become quite different; increasing the pressure leads different phenomena which he believes justifies the view that 39 volts is due to the work done in vaporizing the carbon; he quotes the results obtained by Duncan, which show that increasing the air pressure produces analogous phenomena to that in boiling a liquid, in which case there is a rise in the boiling temperature; more work is done by the current in going through the arc, when it is made more difficult for the carbon to evaporate; in vacuum short arcs require less E. M. F. and long arcs greater than is required at ordinary pressure; it is easier to send an arc through air than through vacuum when it is only one eighth of an inch long, but after that the voltage required increases.

The Electric Arc.—Mrs. Aryton's serial is continued in the Lond. "Elec.," Nov. 9. The resistance used to steady an arc is discussed at some length. The effects of a resistance in series with an arc may be studied graphically or analytically, the graphical method, being the easier, is discussed first; only silent arcs are considered, and at present only the case of a generator of a constant E. M. F., which is considered to be the most important case. The graphical method is explained and discussed at some length. In some cases two results should be obtained, but it is shown why one of them is impossible. Among the conclusions reached she shows the impossibility of obtaining small currents without having a comparatively large E. M. F. in the generator and a large external resistance, which explains the very puzzling results that were obtained in the experiments, the reasons for which are given; for the smallest current and longest arc a voltage of only 86 was required for the arc itself, yet one of 120 was required in each generator to enable the arc to be maintained at all, the remainder being wasted in the resistance which it was absolutely necessary to have in circuit; it is shown that this resistance besides preventing a great current at starting, and enabling a series solenoid to regulate, fulfills a third function, for without some resistance being placed in the circuit external to the arc, it is impossible to maintain the silent arc at all. An arc possesses the very curious property hitherto unpublished, that although a certain current and length of arc correspond to a certain voltage between the carbons, the mere maintenance of this voltage between the same carbons, and for the same length of arc, is not a sufficient condition to insure that that current will continue to flow; this applies more particularly to small currents and small external resistance, and shows why it was impossible to maintain the arc under those conditions; it is concluded that for a given current and length of arc there must be a minimum external resistance, which is independent of the voltage of the generator. This minimum resistance determines the minimum E. M. F. of the generator; for instance a 11-ampere, 5-mm arc requires 55 volts, and a minimum resistance of 0.64 ohm, thus a voltage of 62 will be required, although the arc requires only 55; this minimum resistance was so great, for an arc of 7 mm and a current of 2.5 amperes with solid carbons, that it made the minimum voltage more than half as much again as that of the arc, or about 139 volts, while that needed for the arc was only 86. The minimum external resistance is greater, the greater the length of the arc and the smaller the current; as the apparent resistance of the arc also increases with the length, and is greater the smaller the current, the curious fact follows that when a silent arc is being maintained the smallest possible external resistance is greater the greater the apparent resistance of the arc.

Photographs of the Arc.—The Lond. "Elec.," Nov. 8, publishes as a supplement four photographs taken by Prof. Violle, which were exhibited before the French Physical Society; they were intended to prove that the brilliancy of the crater was the same for currents of 10 to 1200 amperes

and they showed that this was the case; they were taken very quickly with the objective stopped down very much, so that the blacks of the negative were far from saturated, which is an essential condition for accurate photometric comparisons; the two arcs were photographed, one after the other, on the same plate.

Street Lighting by Arc Lamps.—Prof. Blondel's serial (see Digest, last week) is continued in the Lond. "Elec.," Nov. 8. The illumination ought not to be made uniform except under the condition that there should be a certain minimum quantity at the foot of the lamps where there should be an illumination of 10 lux, which permits reading easily; uniform illumination should be abandoned unless this high illumination can be obtained everywhere; he points out the objections to a uniformly illuminating luminous sphere as a source of light, which is approximately the case with diffusing globes; such sources appear more brilliant at a distance than close, which would "completely upset the public"; the vertical illumination of cabs and passengers would increase proportionately to the distance, producing a strange effect; he believes that the time has not yet come to attempt to realize uniform horizontal illumination; the most that may be attempted at present is uniformity of vertical illumination produced outside of a cone of 45 degrees; such a law has the equation that the intensity at any angle multiplied by the sine and the square of the cosine is a constant, from the angle of 45 degrees; the vertical illumination requires a much less rapid increase of the intensity with the obliquity of the rays; beyond a certain distance one should not attempt uniformity, or else too much light will be lost by absorption, the best theoretical curves of the "individual distribution" is given; none of the sources of light actually in use agree even roughly to this; he discusses at some length the height and distribution of lamps; he does not favor high towers, because only a part of the flux falls on the roadway, the least haze or mist absorbs a large amount; the total surface illuminated increases with the height and the mean illumination therefore diminishes; the higher the lamps the worse the vertical illumination; they are useful only in lighting yards, railways, etc., where it is necessary to escape the effects of contrasts. A table giving the height and distance, the width of streets, total number of lamps, etc., in 22 large cities, among which are several in this country, is given; a height of 30 feet is not exceeded in any of these; in Paris they are about 15 to 18 feet high and the distance between lamps is 25 to 50 meters; the illumination of the road falls from 0.37 to 0.18 lux by merely substituting lamp posts 4.45 inches high for those of 4.95 meters, but this does not apply to the vertical illumination; he discusses at some length the distribution of lamps, giving a number of diagrams; the most advantageous solution is to place lamps on the centre line of the street, which is the method generally used to-day; the distances between lamp posts may be made at least equal to the width of the street; it is sufficient to roughly proportion the power of the lamps to the width of the street, then after having given the maximum height, choose a strength of current such that the horizontal illumination for a point under the globe shall attain a fixed minimum value, then to distribute the other lamps at such a distance that the same horizontal and vertical illumination shall be attained; he considers this the most rational rule, but it cannot be followed when the street is too narrow and when the question of expense is considered; to arrange the lamps in a zig-zag line alternately over each sidewalk is a much inferior method; the quantity of light remains the same, but it is not so well utilized; in wide streets a much better distribution can be obtained by reducing the current to one half and doubling the number of lamps; when an intense illumination is desired, the two may be combined into the "quincunx" form, which is specially adapted for large squares and is the method used on Fifth Avenue, New York.

High-Voltage Lamps.—An illustration of the Straus incandescent lamp is published in the Lond. "Elec. Eng.," Nov. 8; there are two separately mounted filaments, each being supported at the upper end by small loops fused into globes; the makers claim that with the special carbon used lamps of 8 and 10 cp can be made to have the same efficiency and durability as the usual 100-volt lamps; the lamps are made from 1 to 280 volts. An extract from a letter by Mr. Baynes of the Bradford station (where 220-volt lamps are used) is quoted, stating that he tested 12 to 14 of the 230-volt 16-cp lamps, and ran them continuously for over 3000 hours without a single breakage; the average watts per cp was 3.2 and 3.1 during the early stages of the test; on examining the bulb after the test one could scarcely tell that the lamps had been in use, there being little or no deposit of carbon on the glass.

Incandescent Lamps.—A report of a committee appointed in the interest of central stations in Germany is briefly abstracted in the "Elek. Anz.," Oct. 13; it seems to contain little of special interest; it is concluded that at the present time the use of 3-watt lamps is recommended as the best practice and the one which is relatively the cheapest.

Train Lighting.—A short article by Mr. Street on a plant in South Australia is reprinted in the "West. Elec.," Nov. 23. An experimental plant has been introduced on one train and is giving excellent results; storage batteries and a charging dynamo are placed in the brake van; the cells are charged by this dynamo, which is coupled to the wheel axle, on a round trip of 280 miles, and the lighting of the train on one or two of the following trips is done by batteries alone. The cost of installing a plant on a train consisting of five cars having six compartments each, one lavatory car and one van, was $3950, and the attendance, maintenance, renewals of cells, etc., averaged $18.43 per week; the cost of lighting with kerosene previously was $20 per week; there have been practically no failures for two years and the system is looked upon as successful in every way; the light, however, is said to be not as good as that usually required.

Electricity for Gas Lighting.—The "Prog. Age," Nov. 15, gives an illustrated translation from an Austrian paper of a device patented by Mr. Denayrouze. A small electric motor in the gas fixture operates a sort of ventilator which sucks in the air necessary for combustion and mixes it thoroughly with the gas, "in order to solve most completely and economically the problem of illumination by incandescent gas light;" he states that the economy attained is from three to four times that of the best gas burners. He also suggested that the current be used to electrolyze water, "the gases from which may be used to enrich the mixture of gas and air, as the nitrogen contained in the atmosphere ordinarily absorbs, unused, a considerable portion of the heat developed;" he adds that precautions must be taken to avoid explosions. (Nothing is said regarding the economy of this latter suggestion, presumably for good reasons, nor is it explained how a mixture of nitrogen with the gases can thereby be avoided as the oxygen from the water is just sufficient to burn the hydrogen.)

Bicycle Lantern.—Mr. Smith, in the "Jour. of Elty," for October, gives the results of some photometric tests of different bicycle lamps; a lantern, burning signal oil, gave 3.25 cp; one, burning kerosene, 6.5, while an electric lamp consuming 4.2 watts gave 45 cp. The weight of these were 20, 40 and 36 ounces respectively, everything included. The electric lantern contained 3 Hough storage-battery cells, and a 1-cp lamp of 4 watts efficiency, consuming 0.7 amperes at 6 volts; one charge is said to run the lamp four hours; the lamps are provided with reflectors, but nothing is said of the area illuminated.

Band Arc Lamp.—A brief, illustrated description of the Siemens & Halske lamp for direct and alternating currents of constant potential, is given in the "Elec. Eng.," Nov. 20.

POWER AND HEAT.

Isar Transmission Plant.—The "Elek. Zeit.," Nov. 7, contains an illustrated description of this plant near Munich, in which the water-power of the Isar River, amounting to about 6000 hp, is to be transmitted electrically to the suburbs of the city of Munich; at present the plant has a capacity of 1000 hp; a reference to this plant appeared in the Digest, June 8. As a large part of the energy is to be used for power purposes, the three-phase alternating system was adopted; the dynamos have a capacity of 350 kw each and generate 5000 volts directly; the longest distance at present is 9 miles; regulation of the turbines is effected by loading the dynamos with a dead resistance; the star system is used, but there does not seem to be a fourth or neutral wire; for small powers, single-phase motors are to be used; the price charged for the current for a 16-cp lamp per hour is 0.85 to 0.5 cent., and for a hp-hour 5 to 2.3 cents. depending on the amount of power used. It appears that permission to supply this current to the city of Munich was refused, and the result has been that a number of factories have moved out to the suburbs, where this power can be had.

New Application of Electric Motors.—The "Zeit. f. Elek.," Nov. 1, describes an application of electric motors in iron foundries which resulted in a great saving; the furnaces are charged from cars run by an electric motor operated from a distance of 20 feet where the heat is not too great for the workmen; formerly four men were required for three hours to do the work which is now done by a single man in one tenth of the time and without subjecting him to the effects of the great heat.

Electric Heating Applied to Castings.—A paper from the Russian, by Mr. Slawjanow, is abstracted at some length in the "Zeit f. Elek.," Nov. 1. In it he describes a method for preventing blowholes from being formed. While the metal is still liquid the surface is heated by an electric arc formed between the metal and an electrode placed over it to keep this portion liquid and enable the mass to cool from the bottom toward the top, so as to enable any gases which are formed to readily rise to the top. The blowholes are supposed to be undoubtedly caused by the rapid cooling of the upper portion. He shows that the other well-known processes for keeping the surface melted have not been a success: the temperature of burning coals is too low to keep the steel in liquid form; the use of liquid fuel, like naphtha, is apt to introduce too much carbon into the steel, making it cast iron, or at least a very hard, useless steel; hydrogen would answer the purpose were it not for the great cost. The electric method has been in use for some time in a Russian ordnance factory. The metal is made the positive pole, while the negative electrode is of steel or carbon, the top of the mould being covered with a heat-insulating material through which the electrode passes; ingots of 10,000 and 20,000 pounds were thus treated, the currents being 800 amperes, at 60 to 70 volts, and the time 2.5 to 5 hours; the result was not quite as good as was expected; the metal was very dense, but not quite to the top of the surface, the top layer of about 10 per cent. being porous, but it is believed that this difficulty can be overcome; the metal on the upper surface is too poor to use. He compares the cost of the dense metal produced by the old process and by this one under the assumption that in the former

one third of the metal is useless, and he finds that the useful portion of the metal which has been heated with the electric arc costs 10 per cent. less when it is Martin steel, and 21 per cent. less for crucible steel, thus showing that the process in large establishments would involve a great saving, and it would also increase the output of the foundry, as it makes it possible to cast much larger ingots.

Smelting Furnaces.—A brief, illustrated description of a small electric furnace for fusing samples, and another for continuous operation, are described and illustrated in the "Electrochem. Zeit." for November. They are used in an installation in Germany for separating gold and silver.

TRACTION.

Earth Returns from Railways.—According to the Lond. "Elec.," Nov. 8, Dr. Froelich, on behalf of Siemens & Halske, stated that means appear to have been found to render the earth currents unobjectionable (referring to the disturbances which they might cause in the delicate measuring instruments at the Reichsanstalt); these currents are not stray currents, but pass from the rails to the generator through the earth in curves which can be accurately (?) ascertained; such determinations of the curves have been made in the Siemens laboratory and on the Dresden railway, where the accuracy of the method was tested and found trustworthy; it is proposed to connect metal conductors at certain intervals to the rails and lay these in the direction of the earth return-curves; buildings for which special protection is desired are to be encircled by a number of wires attached to these cables; the cost of these extra circuits, it is believed, will not be very great; the varying conditions of weather and seasons are met by using regulating resistances placed in each compensation circuit; he hopes that in using this system the objections to using the earth-return for railway work will be overcome and the disturbances reduced to a minimum.

Accumulators for Trolley Lines.—The "Elek. Anz.," Nov. 2, illustrates a suggestion by Mr. Mueller to use the storage battery to help cars on trolley lines in mounting a steep grade; it consists simply in connecting a battery to the trolley wire at that point; when there is no car on the line the voltage will be sufficient to charge the battery, while, when a car is mounting the grade, the loss of voltage on the line will be sufficient to cause the battery to discharge through the car; (no other data is given and it is not stated how great a difference in voltage there must be to operate such a system satisfactorily; theoretically, it would be ideal, but unless the fall is very great, it would probably not operate so well in practice.)

An Electric Surf Railway.—An odd form of electric railway, which is about being built at Brighton, England, is described and illustrated in the Lond. "Elec. Eng.," and more briefly in the Lond. "Elec.," Nov. 8. A steel structure is to be run through the water, parallel with the shore, a total distance of about three miles. The main object of the line is to attract traffic by the novelty of running through the waves in a sort of hybrid tramcar-lifeboat; it is expected that the line will be running by next June. The rails are laid slightly above low-water mark, and at high tide they are covered by 14 feet of water. There are two pairs of rails, 18 feet apart, laid separately on concrete blocks mortised to the chalk rock foundation; the wheel base is 28 feet. Each of the two leading trucks will be driven from vertical shafting, passing up through the tubes forming part of the structure, by a 30-hp vertical motor, the current being taken from an overhead trolley wire. The deck of the car will be 24 feet above the rails and measure 50 x 22 feet; the structure weighs 40 tons, and with a motor car and 150 passengers, 60 tons; a speed of six miles an hour is expected.

Conduit System.—A well-illustrated description of the Hoerde system, which has been referred to a number of times in these columns, is published in the Lond. "Elec. Rev.," Nov. 8.

Preventing Electrolysis.—In a communication to the compiler, Mr. Brown supplements the description of his system, which was abstracted in the Digest, March 30 and Oct. 12. There are two problems involved; first, the maintenance of the pipe more negative than the rails at all points, thereby checking the corrosion of the pipes at some bad joint and at the same time slightly increasing the current in them; second, the maintaining of the distance rails and the near pipes at nearly the same potential, thereby cutting down the pipe current to its minimum. He states that there is no difficulty in keeping the two sets of dynamos at the proper difference of potential to secure this result, and he believes it will reduce the load on the power station about 20 per cent. A poor joint can be detected on the surface of the street and the action stopped by connecting the return wire to a point beyond the poor joint. He calls special attention to the importance of carrying the wire from the higher pressure dynamo out to the far distance ends of the rails. He thinks that the greatest loss in railway transmission is encountered in the rail returns due to the thermoelectric series of steel and copper formed by the rail and bond wire. In practice he finds that keeping the near ends of the pipes and the distant rails at about the same pressure stops electrolysis; also that one setting of the rheostat for each set of dynamos is sufficient to maintain the same difference of pressure irrespective of the variations of the load.

Rail Bonds.—A number of the best-known types of bonds are described and illustrated in the "Elec. Ry. Gaz.," Nov. 16. Among them is a new form of the plastic rail bond in which the connectionis made by drilling a hole through the top of the rail and into, but not through, the top flange of the angle plate; this hole, after being amalgamated over its inside surface, is filled with the plastic alloy and closed with a soft iron plug, which is forced into the top; with a ⅝-inch hole it is equal in conductivity to a copper bond ⅞-inch in diameter; as the alloy remains soft no harm can result to the joint from the slight motion of the rail; this is not designed for new work, as it is not as good as the other form of plastic bond, but it is preferable for existing roads on which better conductivity is desired.

Electric Car Tests.—Prof. H. S. Hering's serial is continued in the "Elec. Ry. Gaz.," Nov. 16. He discusses the performance of cars in regular service, and shows a large number of speed records. He gives the results of experiments showing the effect of the way in which the controller is handled by different motormen, and finds that there is a saving of 20 per cent. if the controller is operated by an intelligent electrician, over that used when it is operated by the average motorman; (see also The Electrical World, Nov. 9, p. 516); the amount of energy used by the same motorman on successive trips, under the same conditions, was found to be the same, generally within 1 per cent. He finds that the difference between running past a station and stopping and starting again averaged about 85 watt-hours, which, at 1 cent per kw-hour, amounts to nearly 1-10 of a cent.

Surface-Contact System.—A description of the "E. M." system (see Digest, Nov. 9), including some further illustrations of details, is given in the "El. Ry. Gaz.," Nov. 16.

B. & O. Locomotive.—A further description showing some of the features which have not yet been described is published in the "Elec. Ry. Gaz.," Nov. 16.

Motor Vehicle Contest.—The rules, route, entries, method of testing and illustrations of some of the contesting vehicles are published in the "Elec. Jour.," Nov. 1. Prof. Dolbear in the same issue endeavors to show by calculations "the reasons why electric carriages have not been seen on the roads and why they are not likely soon to be," the chief objection being the weight; naphtha and petroleum engines weighing but 200 pounds, he states, can be made to give 3 or 4 hp for a run of 100 miles at a cost of but "a dollar or so."

Car Wiring.— A well-illustrated description taken from the "Sc. Amer.," showing, by means of simple diagrams, the complete connections on a car, is reprinted in the "Elec. Jour.," Nov. 15.

Steam and Trolley Lines in Connecticut.—An article of some length, by Mr. Deming, is reprinted from the "Railroad Gazette," in the "Elec. Rev.," Nov. 20.

New Orleans.—The "Elec. Ry. Gaz.," Nov. 16, begins a description by Mr. Smith, of the overhead feeder and trolley construction of the New Orleans Traction Company's lines.

Waterloo Tunnel Plant.—An abstract of the article which was noticed in the Digest, Nov. 23, is reprinted with some of the illustrations, in the "Elec. Eng.," Nov. 20.

Subway in Boston.—The "Elec. Ry. Gaz.," Nov. 16, and the "West. Elec.," Nov. 23, publish an illustrated extract from a report of the chief engineer. It is limited to the civil engineering features.

An Electric Surf Railway.—A brief description, with an illustration of the car, of the Brighton railway, noticed above, is reprinted in "El'ty," Nov. 20.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Increasing the Voltage to 220.—According to the London journals, a report made to the managers of the Hull station recommends changing from 110 to 220 volts; no action has yet been taken. The Lond. "Elec.," Nov. 8, in discussing this question, states that apart from the question of the durability of 220-volt lamps there arises the question who is to pay for the first batch of lamps. The electrician of that station proposes to settle this question by giving all customers new lamps for the old, and estimates that after allowing for the sale of the discarded 110-volt lamps, the change can be effected at a net cost to the company of $7500; some 15,000 lamps are concerned. It is suggested that this method would be somewhat expensive for some of the large London stations, which have 80,000 to 100,000 lamps connected; the remedy is better suited to small stations than to well-developed large ones, in which an increase in the feeders is suggested as probably the better plan. It is a question whether the Board of Trade will allow the switches and cut-outs to be used with the higher voltage. (Might it not be a more practical method to change over gradually, one building at a time, by first connecting the high-volt lamps across the outside mains and using up the low-volt lamps in the other buildings; the change from 220 to 440 volts can then be readily made after the 110-volt lamps are all used up; the change of connections would be made at the meter ends so as not to interfere with the house wiring.)

Municipal Lighting Station in Chicago.—An illustrated description of the West Side Park lighting station, on which work is about to be begun, and which will be one of the largest arc lighting plants in Chicago, is published in the "West. Elec.," Nov. 23; it will have a capacity of 700 all-night lamps of 2000 cp, and will cost, exclusive of land, about $200,000; the conditions of working are very good, as the entire load will be constant every night with ten hours of service; it is estimated that the cost

of operation per lamp per hour will be 1.14 cents, not including interest, water or taxes.

Edinburgh.—An abstract of the descriptive article mentioned in the Digest last week is reprinted in the "Elec. Eng." and "El'ty," Nov. 20.

Lightning Arresters.—The article from the German, mentioned in the Digest, Nov. 9, is reprinted in abstract in the "Elec. Eng.," Nov. 20.

WIRES, WIRING AND CONDUITS.

Rules and Regulations.—Those concerning electric installations in Paris are published in "L'Eclairage Elec.," Oct. 26.

Bus-Bars and Cables for the Niagara Plant.—A short description, with illustrations, is given in the "Elec. Eng.," Nov. 20. The cable used for connecting the dynamos to the switchboard, of which about 1200 feet have been supplied, was tested under 45,000 volts. It contains 427 copper wires, consisting of 61 strands laid in reverse layers, each strand consisting of 7 wires; next to this is rubber ¼ inch thick, which is wrapped with pure rubber, over which are laid two wrappings of vulcanized Para rubber, then a wrapping of cut sheet, over which are two more rubber coats, after which it is tapped, braided and vulcanized. It weighs 4 lbs. to the foot, 3 lbs. being copper and 1 insulation.

ELECTRO-PHYSICS AND MAGNETISM.

Magnetic Force Due to a Current.—The Lond. "Elec.," Nov. 8, contains a short article by Prof. Minchin, in which he shows how to calculate practically the component of magnetic force parallel to the axis of a coil at any point in space; a few numerical examples are added. This is followed by a short article by Mr. Russell, on "The Magnetic Force at Any Point in a Plane Due to Electric Currents," and in which he describes a graphical method of calculation, which is easily applied in practice.

Alternating Currents of High Frequency.—A reprint of Dr. Tuma's article, an abstract of which was noticed in the Digest, last week, is begun in the "Zeit. f. Elek.," Nov. 1.

Graphical Calculations for Currents of Any Wave Form.—An article by Dr. Roessler (see Digest, Nov. 16) is concluded in the "Elek. Zeit.," Nov. 7. He discusses the application to transformers.

Variation of Conductivity of Wires in Different Dielectrics.—The "Phys. Rev.," November-December, contains a long paper by Mr. Sanford in which he gives the results of further investigations to supplement those which he published some years ago, the accuracy of which was questioned by other authorities; in the former experiments he found that the conductivity of a wire was different when surrounded by different dielectrics and he therefore suggested that Ohm's law ought to be modified to comply with this newly discovered fact. In the present article he cites a paper by Prof. Grimaldo and Dr. Platania from the Italian, giving the results of a long and carefully made series of experiments on the resistance of copper wire in air and in petroleum; these results, he states, show remarkable concordance with those obtained by him; the resistance of the wire in petroleum was always found to be less than in air but the percentage amount was only about 1-12th as great as that found by him; he thinks it improbable that the existence of the phenomenon will again be questioned. The method and apparatus in his latter tests were the same as in the earlier ones; the results are given in tables and curves for eight different dielectrics, in which the change of temperature which would be necessary to account for such a variation is also given; silver wire showed the same as copper, except that the variation was not so great, and that while copper had a lower resistance in petroleum than in air, with silver it was slightly higher. To determine whether all of the dialectric is concerned or only a thin layer of it in contact with the wire, he made some experiments in which the wire was first coated with paraffine oil and found that the resistance was then exactly the same in two different dielectrics, which led him to believe that the phenomenon is due to a very thin film of the dielectric adhering to the surface and probably absorbed to some extent by the wire, as in some cases the wire required a considerable time to return to its air resistance after the tube had contained a liquid; experiments were also made with flattened and with thin wires, but he concluded that more delicate methods were required for these; a silver wire was copper plated, but this did not seem to change the results. The only explanation which he offers is based on the assumption that the passage of a current through a metallic conductor is accomplished by means of disruptive discharges from molecule to molecule through the intervening ether; such discharges would consist of oscillations, although those in one direction will be much greater than those in the opposite, and the rate of oscillation will depend on the elasticity and density of the intervening ether. He believes that gases penetrate some distance into the metals. One conclusion which follows from this hypothesis is that the variation in resistance should be greater for alternating than for direct currents, but he has not been able to verify this.

Changes of Length of Iron Wire Due to Magnetization.—The "Phys. Rev.," for November-December, contains an article of some length, by Mr. More, in which, after giving a short historical summary of the subject, he describes some researches undertaken at the suggestion of Prof. Rowland. The summary of his results is as follows: "A relation has been obtained between the elongation due to magnetization and the intensity of magnetization for soft iron. When the elongation has been corrected for the contraction caused by the $\frac{\mathfrak{B}^2}{8\pi}$ force, the relation may be expressed thus: A rod of iron elongates slowly until an intensity of about 800 is reached. After that point the rod elongates more rapidly and attains a maximum value of about 60×10^{-7} part of its length at an intensity of 1200. With greater intensities the elongation diminishes, the curve being approximately a nearly vertical straight line. Hardening the wire diminished the corrected elongation, and the wire attains its maximum length in a less intense field. It has been shown that when the wire is stretched, the change in elasticity due to the magnetization produces an important effect. Neglecting this correction, the effects of stretching are similar to those caused by hardening the wire."

Relations of Hysteresis to Temperature.—The article by Messrs. Laws and Warren, which was abstracted in the Digest, July 13, is reprinted in full with illustrations in the "Tech. Quart.," for July.

ELECTRO-CHEMISTRY AND BATTERIES.

Electro-Metallurgy of Zinc-Lead Ores.—The "Zeit. f. Elektrochem.," Nov. 5, contains a very long article by Mr. Lorenz, in which he describes a method for obtaining lead and zinc from ores containing both of them; as the wet processes have not been successful, he electrolyzes the fused salts and separates the two metals by a single process; as salts he uses the chlorides. The "Elektrochem. Zeit." for November publishes the illustrations, accompanied by a description from a German patent of Lorenz, for such a process. There is no doubt that this process is the same, and due to the same author, as that in the paper referred to above.

Accumulator.—A brief description, accompanied by some illustrations, of the I. E. S. accumulator (see Digest, July 6 and May 18) is given in Lond. "Lightning," Nov. 7. The cast grid consists of a number of wires, on which are threaded celluloid shelves, which seem to be the principal feature of the invention. The active material is then applied in the form of paste, and the plate is enclosed in an envelope of porous celluloid.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Specific Inductive Capacity.—"L'Eclairage Elec.," Oct. 26, contains an illustrated description, accompanied by the theory, by Mr. Pellat of his absolute electro-dynamometer for measuring the specific inductive capacity of solids and liquids; it is based on the increase in the attraction of the plates of a condenser when the air between them is totally or partially replaced by another dielectric; as this attraction depends on the voltage, the opposing force should be another electric attraction produced by the same voltage, they being measured by a zero method; it consists of a double Thomson electrometer. He has obtained good results with petroleum; with high frequency voltages of a million per second, for instance, as given by condensers, or 100 million, as given by the Hertz apparatus, it is probable that one can measure directly the specific inductive capacity of a body having a certain conductivity, like pure water, for instance.

Influence Machines.—In an article by Messrs. Schmidt and Ruehlmann in the "Wied. Ann.," Vol. 56, p. 167, noticed briefly in the "Elek. Zeit.," Nov. 7, they show that the output of a Holtz machine may be increased 25 per cent. by actual measurement by increasing the width of the foil on the stationary plate from 10 to 14.5 cm and increasing the pointed combs to a double row of 31 points, 16.5 cm in width; the diameter of the discs is not given; the increase in quantity of electricity was proportional to the speed.

Protecting Instruments Against Vibration.—Somewhat longer abstracts of the papers by Mr. Julius and by Mr. Einthoven, which were noticed in the Digest, Nov. 2, are given in the "Elec. Zeit.," Nov. 7.

Thermophone.—The "Tech. Quart.," for July, contains a very long article by Messrs. Warren and Whipple describing a "thermophone" for measuring temperature at a distance or at inaccessible places, which was originally devised for finding the temperature at the bottom of a pond of water. It resembles the Siemens' apparatus, and is based on the principle of the Wheatstone bridge, and the fact that different metals have different temperature coefficients. Two coils of different metals are placed in proximity to each other and made the two arms of a Wheatstone bridge; they are placed where the temperature is to be measured, the other two arms being placed where the readings are taken. It is said to be extremely sensitive; the resistance ratio changes about 1 per cent. for each 5 degrees; the average range of atmospheric temperature from −15 degrees to +115 degrees F. is easily measured to 0.1 degree; the coils are made of copper and German silver, and a telephone is used in place of a galvanometer; numerous results of measurements are given. A brief description of the same instrument is published in the "Elec. Age," Nov. 23.

Photographic Current Indicator.—An apparatus devised by Dr. Crehore for determining the character of currents is illustrated and briefly described in the "Elec. Eng.," Nov. 20; the objections to the inertia of mechanically vibrating parts, are avoided by using a beam of light whose plane of polarization is rotated by passing it through a solenoid in which

the current is passing; the light after passing through the solenoid is then recorded by a photographic method.

Photometer.—In Prof. Thomas' serial in the "Elec. Jour.," Nov. 1, he gives illustrated descriptions of the Lummer-Brodhun and the Weber photometers.

Location of Grounds on Lines.—The Varley loop test is described by Mr. Baker in the "Elec. Jour.," Nov. 15; it is said to be specially applicable to underground cables in cities.

Measurements of Insulation Resistance.—In the "Elec. Jour.," Nov. 15, Prof. Anthony supplements a description which was abstracted in the Digest, Oct. 5, by a few further explanatory remarks.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Avoiding Induction from Railway Circuits.—In the "Jour. Teleg.," Oct. 25, Mr. Pierard suggests a method for avoiding the noises in single-wire telephone lines, due to induction from railway circuits; instead of using the earth, a return wire common to a large number of circuits is used; to obtain perfect neutralization he states that exactly the same electric conditions must exist on this common return, especially the capacity and the self-induction, as on the outgoing lines; the return wire should therefore be of the same nature, diameter and length as the outgoing lines, and should not have the highest possible conductivity as it was formerly believed it should have; the return wire should be carried as nearly as possible to the central station. The calling apparatus is then increased in sensitiveness to such an extent that the calling current divides through the circuits, thereby causing confusion, and to avoid this he states that the return wire should not be placed in circuit until after the calling signal has been sent; a telephone station should therefore be provided with an automatic apparatus replacing the local earth by the return wire, when the telephone is unhooked; he describes and illustrates such an apparatus; this system has been used with complete success at Brussels and Liege.

Telephony in Holland.—The "Elek. Zeit.," Nov. 7, publishes an abstract at some length from a recent article, and discusses it editorially.

Long-Distance Visual Signaling.—The Boughton "telephotos" are described and illustrated in the "Elec. Eng.," Nov. 20. The apparatus consists of a keyboard similar to that of a typewriter, and a flexible shaft provided with a white and red incandescent lamp, which are used to denote the dot-and-dash of the Morse system; this flexible shaft weighs 29 pounds, and can be run to the top of a ship's mast very readily; it is said that the lights, which are eight feet apart, can be seen in any direction; it is also stated that there are 12 lamps of 100 cp; "the weight of each lamp is 5.5 pounds." (The description is not very clear, as in one place it states that there are 12 lamps, in another 2 and in another 6, while the drawing shows one, and it is not explained why a set of typewriter keys are used to send the simple Morse signals.)

Substitutes for Magnetos in Telephone Exchanges.—The "Jour. of Elec." for October describes a system which is used in San Francisco; a slow-speed fan motor of 1-12 hp is used, and is provided with two collector rings connected to diametrically opposite points of the armature, from which an alternating current is obtained which is used for calling; it will operate from 10 to 15 calls simultaneously satisfactorily.

MISCELLANEOUS.

Properties of Glucinum.—According to the Lond. "Elec. Eng.,"Nov. 8, this metal is likely to become a useful one in electrical work; it is twice as heavy as water and therefore even lighter than aluminum; it is less expansible than iron and has an electric conductivity greater than copper and nearly equal to that of silver; it is more durable than iron; at its present price, about $18 per pound, it is one tenth the price of platinum weight for weight, and one 1-160th the price volume for volume.

Electric Steering Apparatus.—Among a large number of mechanical applications, described and illustrated by Mr. Richards, in "L'Eclairage Elec.," Oct. 26, are included automatic steering compasses, steering machinery, etc.

Durability of Porcelain.—Mr. Pass, in the "Elec. Eng.," Nov. 20, discusses the subject of porcelain as an insulator, stating that when well made it is better than glass, especially for high voltages, but that in the manufacture the glazing is apt to crack, and it should then never be used as an insulator; this tendency to crack also exists for some time after it has been manufactured. He recommends that the porcelain be examined more thoroughly, and gives as one reason why it is so often unsatisfactory that the price seems to be the only thing considered by the people who buy it. He recommends that all porcelain should bear the manufacturer's name, and that there should be a rigid inspection to prevent the use of porcelain with cracked surfaces.

Night Photography by Electric Light.—The "Jour. of Elec." for October contains an illustrated article by Messrs. Mullander and Sprout describing an apparently simple method of photographing at night; it is accompanied by a number of good illustrations of the Midwinter Fair, showing the illumination effects.

Danger with Alternating Currents.—Referring to the recent accident to Mr. Pope, Prof. Carhart, in the "Elec. Jour.," Nov. 1, calls attention to a feature of alternating currents due to the capacity of the circuit. Even with perfect insulation a 1000-volt circuit may not be safe to ground through a person. He cites a case in which the insulation resistance of such a circuit was unusually high and in which a series of five lamps of 100 volts, connected between the ground and the line, were found to light up with nearly full candle-power, the explanation being that the line, which was in part a cable, had sufficient capacity to produce this effect.

Physiological Action of Acetylene.—The "Elec. Eng.," Nov. 12, contains a short paper by Dr. Birchmore on this subject.

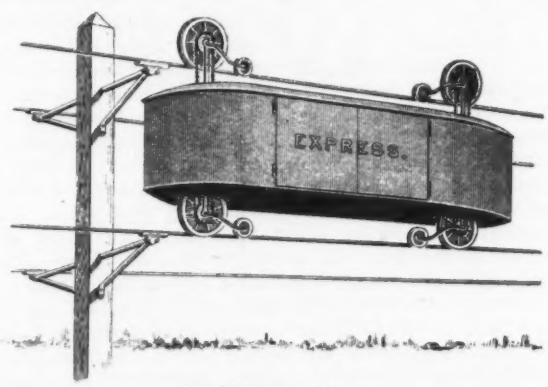
Magnetism in Surgery.—"Elec. Age," Nov. 16, states that recently in a New York hospital a piece of steel "three eighths by one quarter inch in size," which had become imbedded in a man's eye, was successfully extracted by bringing the eye near the poles of a very strong electromagnet. This method was used in preference to a surgical operation, as "the location of the piece of metal in the eye was uncertain."

Biographical.—A full-page portrait of Ohm is published as a supplement to the "Elec. Jour.," Nov. 1, and one of Volta in the issue of the 15th. A biographical sketch, with portrait, of Mr. Harold Brown is published in the "El. Ry. Gaz." Nov. 16.

An Electric Telpherage System.

An interesting electrical express system has been just put before the public by the Electric Express & Transportation Company, 253 Broadway, New York. The principle is not new, but no one seems to have applied it to the service which this company suggests. It is a magnified cash and bundle delivery system, intended for the rapid transportation of mail and express matter from large cities to the suburbs, and even to outlying towns. It is expected that the street railway managers, and those who have a line of poles and power at their command, will be chiefly interested in such an enterprise.

The illustration below shows an express car which is intended to carry considerable matter, but is of light weight, and particularly designed for a minimum wind resistance. On none of the cars would a motor exceeding two or three horse-power be required, and with this a speed of 20 miles an hour is readily obtained. The motor, as has been intimated, is upon the car itself, and drives by belts, chains or other convenient transmission the supporting wheels of the car, and thus propels it. Power is supplied to the car through the two cables on which it rests; about one third of the weight is carried by the lower cable, the balance being supported by the upper one. The system is primarily intended to operate on merely local lines, and it is estimated that it will be more profitable in small installations.



An Express Car.

The operation may be described as follows: Imagine five consecutive stations, *A*, *B*, *C*, *D* and *E*, beginning at the centre of a metropolis and reaching out toward the suburbs. Mail and express matter is delivered at all of these stations, of course most of it going to station *A*. A car is sent out from *A* with matter for *C* and *D*, but none for *B* and *E*; *C* is notified by a bell or telephone, as may be convenient, and the car passes by station *B*, while *C*, being warned of its arrival, throws a switch which interposes a dead section at a suitable interval and brings the car to a standstill at his station. He removes the packages intended for him, and then, finding that there are also packages intended for *D*, he closes the car, starts it and warns *D*. In the meantime, if he has any packages for the central station, he stops the first car going in that direction, puts his packages aboard, and warns the first of the recipients to which the car will come. In short, the system is so flexible that any method may be employed that the management considers advisable. A second method of stopping the car is proposed in the shape of a mechanical clip against which the car impinges, and which throws a switch in the interior. It is expected that the operators of the sub-stations can readily be boys from 17 to 18 years of age, and the salaries will be correspondingly low. The main operator will have general charge of the line, and be the only high salaried man employed. The cost of such an installation is estimated at $2500 per mile.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Nov. 23, 1895.

WESTERN UNION opened down on Monday and continued in the neighborhood of 87–88 throughout the week. The recent Supreme Court decision invalidating the Western Union and Union Pacific contract seems to have been in large measure responsible for the break, and the indications are that some of the interests usually bullish on Western Union are now on the bear side. They think there is enough that is unfavorable in the situation to carry the price several points lower, especially if long stock comes out. One of the leading bears on Western Union says: "The point made of competition for business along the railways, of which Western Union has had a practical monopoly for many years, is the most important one yet made. The cost of maintaining 12,000 to 14,000 offices is an immense item per annum, running into the millions. The revenue from these offices, the expenses of which are paid by the railways, has been figured by good judges at not less than $7,000 000 per annum." On the other hand, the bulls claim that there was not sufficient profit in the business done with the Union Pacific offices to cause the decision seriously to affect the Western Union Company's earnings. Director Terry, of Western Union, says test offices show a gain of $25,000 a week over last year. For the calendar year 1895, it is expected that the company will earn $600,000 above all charges and dividends.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	96	97½
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	37	37½
Electric Storage, pref	100	38	38¼
General Electric	100	30½	30⅝
General Electric, pref	100	60	63
Westinghouse Consolidated, com	50	34	34½
" " pref	50	54	54½

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	198	199
American District Telegraph	100	35	40
American Telegraph & Cable	100	92	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
*Erie Telephone	100	60	..
Gold & Stock Telegraph	100	105	..
New England Telephone	100	85	..
Postal Telegraph-Cable	100	82	83
Western Union Telegraph	100	87⅜	87½

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17¾	17⅞
Binghamton RR. com	100	100	..
Brooklyn Traction	100	12	15
" " pref	100	59	61
Buffalo St. Ry	100	72½	74½
Cleveland City Ry	100	69	70
Cleveland Electric Ry	100	59	60
Columbus St. Ry	100	52	54
Consolidated Traction of N. J	..	25	..
Electric Traction, Philadelphia	50	..	..
Hestonville	100	55¾	..
Long Island Traction, all pd	100	15¾	16¼
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
New Orleans Traction	100	17½	19½
" " pref	100	68	70
North Shore Traction	100	32	34
" " pref	100	83	85
People's Traction, $30 pd	25	..	..
Philadelphia Traction	50	72	72¼
Rochester St. Ry	..	..	38
Steinway, Ry	..	46	..
Union Ry. (Huckleberry)	100	112	115
Union Traction, rcts $5 pd	..	13¼	14
West End, Boston	100	69	69½
" " pref	100	93	..
Worcester Traction	100	15	17
" " pref	100	84	86

BONDS.

Buffalo St. Ry. 1st con. 5s	100	102	105
*Binghamton Railway Co. 5s	100	90	100
Cleveland Elec. Ry. 1st mtge 5s	100	102	104
*Columbus St. Ry. 1st 5s	100	93	101
Rochester St. Ry. 1st 5s	100	102½	104
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.
† Ex-Div.

ELECTRIC STORAGE was rather active on the Philadelphia Exchange floor this week, but considerable liquidation in both stocks forced them steadily downward. Good support was given on Monday, and the common stock moved up ½ point, but on Tuesday, under heavy selling pressure by a room trader, presumably acting for a commission house, the price declined sharply to 40½, with a final fractional rally to 41. The preferred stock was taken at an advance of one point on initial sale to execute a small buying order, with next sale at 46, after which, like the common stock, it was subjected to pressure and declined to 41, at which final sales were made. From Wednesday's opening until to-day's closing, the pressure proved too strong, and the stocks steadily declined.

THE TRACTION MARKET this week has been dull, with decidedly more "talk than trade." In spite of the continued rumors regarding the leasing of the Brooklyn Traction Company by the Nassau Company, the securities of the former continued inactive and heavy. During the past three days reports have been current on the street that the deal was likely to fall through, and the incorporation of the East River & Atlantic Ocean Railway Company would seem to lend some color to this rumor. The new company is said to have been formed for the purpose of giving some direct outlet to the Nassau road. For this purpose a line will probably be constructed to the Thirty-fourth Street Ferry in Long Island City, and will connect with the already established branches. The capital stock of the new company will be $3,000,000, and the following Board of Directors has been named: P. H. Flynn, Frederick C. Cocheu, Silas B. Dutcher, George S. Studwell, Joseph B. White, William J. Studwell, J. C. Brower, M. J. Kennedy, of Brooklyn, and James F. Casey, of Albany.

BROOKLYN CITY RAILWAY.—Rumors that the Brooklyn Bridge trustees will take some immediate action to improve the terminal arrangements has apparently had a strengthening effect on Brooklyn City Railway stock. This security closes in somewhat better demand

BUFFALO STREET RAILWAY, after its spurt of last week, has again reacted, and sales are reported around 73½. The consols, however, are somewhat firmer on very limited trading.

WEST END STREET RAILWAY.—The eighth annual report of the West End Street Railway Company, for the year ending Sept. 30, 1895, with comparison, is as follows:

	1895.	1894.
Gross receipts	$7,746,170	$6,823,879
Operating expenses	5,633,163	4,807,083
Net	2,113,007	2,016,795
Charges	746,063	725,064
Balance	1 366,044	1,291,731
Dividends	1,102,525	1,193,375
Surplus	263,519	98,356

Against the $263,519 surplus is charged $222,822 as value of tracks taken up, bad debts, etc., leaving balance of net income carried to surplus account $40,696.

NORTH SHORE.—The report of the North Shore Traction Company for the year ending Sept. 30, 1895, shows that the gross earnings have increased $38,083, and that the net earnings are ahead of a year ago.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Nov. 25, 1895.

MR. J. H. REID, Chicago representative of the Westinghouse Glass Factory, spent a few days in New York last week.

CHARLES A. SCHIEREN & CO., 45 Ferry Street, have just been advised that they have been awarded the silver medal—highest award—for leather belting, by the Atlanta Exposition.

H. B. COHO & CO., have just completed installing in Hammerstein's new Olympia Theatre four 100-kw, Eddy "type G" generators. These generators were given a severe test at the factory by Mr. Hammerstein's engineers, and were found to be entirely satisfactory.

THE CHESLEY ELECTRIC COMPANY, 601–605 Newark Street, Hoboken, N. J., has opened an office in the Havemeyer Building, in charge of Mr. W. J. Johnson. The company reports a number of sales recently of second-hand machines, of which it makes a specialty, and its repair shops have been kept so very busy as to necessitate the addition of several heavy machines to the factory equipment.

THIRD AVENUE COMPANY ACQUIRES THE BOULEVARD LINE.—The Third Avenue Railway Company is reported as having leased the Forty-second Street, Manhattanville & St. Nicholas Avenue line, familiarly known as the Boulevard line. In connection with the projected Kingsbridge route the Boulevard line will form a trunk road along the west side as far as Yonkers, with a down-town connection as far as the City Hall. Still another down-town connection on the east side will be afforded by St. Nicholas Avenue and 110th Street, which forms one of the branch of the Forty-second Street, Manhattanville & St. Nicholas Avenue system. So far plans have not yet been perfected for the operation of the new line, as the formal transfer of the property will not be made until Dec. 30, in order to give the old company

an opportunity to wind up its affairs and close its books. The old horse-car service will be abandoned, however, and it is considered probable that an electric conduit system will be installed.

New England Notes.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Nov. 23, 1895.

MR. HENRY SACHS has accepted the management of the Cole & Gerald Manufacturing Company, 45 Massachusetts Avenue, makers of high-grade bicycles, and expects to establish selling agencies with the electrical supply dealers throughout the country.

THE ANCHOR ELECTRIC COMPANY reports gratifying success in the sale of its watchman's register, the demand for which recently has been unusually large. One of the most important contracts taken was one for 10 instruments for the Atlanta Exposition, the buildings of which are now protected exclusively by the Anchor Company's registers.

W. D. HOFFMAN & CO., contracting engineers, 620 Atlantic Avenue, have just completed their contract with the Worcester Engineering Company for a steam plant at Milbury, Mass., for the Milbury Water Company. The system furnished consists of an 180-hp horizontal cross-compound engine, to work under a steam pressure of 135 lbs., the power being transmitted from the engine to three throws-vertical pumps. Messrs. Hoffman & Co. have lately placed several large Slater engines in Rhode Island, Maine and Massachusetts. They have on exhibition at the Mechanics' Fair one of the new model Dick & Church improved high-speed engines of 75 hp, the regulation of which is guaranteed to be within 1 per cent. They also display in two separate exhibits the McClave system for burning cheap fuels, by which any of the hard fine coals mixed together, or fine hard coals mixed with soft coals, can be burned with great economy.

THE HIGHAM ELECTRIC COMPANY, 168 High Street, is now ready for the transaction of business on an aggressive and energetic basis, and the Higham arc lamp manufactured by this company for direct-current constant-potential circuits will undoubtedly command the quick recognition its merits deserve. It is something of a departure in arc lamp construction, and all the claims made for it have been conclusively demonstrated by most severe tests. A reported record of a pair of Higham arc lamps in series with a resistance coil on 110-volt circuit was 51 volts for each arc, one volt for each feeding magnet mechanism, and six volts for the resistance coil, thus making over 92 per cent. of the total watts consumed at the arc in giving light. The regulation of candle-power was absolute, the light showing perfect steadiness. The Higham Company starts business under decidedly favorable auspices, and invites orders for trial lamps, to prove by actual tests the exactness of the claims made.

Pittsburg Notes.

THE CARNEGIE & PITTSBURG ELECTRIC RAILWAY COMPANY is extending its tracks over the line of the Panhandle (steam) line (known to be controlled by the Pennsylvania Railway Company) at the west end of the town of Carnegie. Some 60 men are at work grading, laying the ties and rails and extending the feeder and trolley wires. The work has been hanging fire for five months, pending the injunction issued by the steam company. It has been determined that in less than a year this electric road has been in operation the local travel and freight business has more than doubled. The length of line from this city to Carnegie is nearly nine miles and runs almost parallel with the Panhandle (steam) road, but although it is almost a mile longer by the electric road to this city, the trolley people push some of their cars into town within 18 minutes of the time of the steam line. There is a difference of some 13 cents in fare in favor of the electric lines.

THE WEST END ELECTRIC STREET RAILWAY COMPANY, by the construction of two different lines to Grafton and Carnegie, has absolutely precluded all competition from the territory, and, so far as transportation by electricity is concerned, it now enjoy a monopoly of the business. This new line, well under way in the course of construction, runs right through the centre of Sheridan, Ingram and Grafton, and will connect with the old line about midway between Idlewood and Grafton. The ravine through which the old line runs is the only available entrance for a railway in that direction, and the new line holds the key to the situation from the lower river district. This new line follows the tracks of the Panhandle steam road and runs through a very populous district which is growing rapidly. It is said in electric circles that after the line is finished through Grafton, Ingram and Sheridan most of the Carnegie cars will be run that way, and only a few cars will run *via* the old line.

Western Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Nov. 22, 1895.

MR. T. C. RAFFERTY, president of the Dearborn Electric Company, is on a trip East.

MR. W. H. McKINLOCK, president of the Metropolitan Electric Company, left for Omaha Monday evening on a business trip.

THE MOON MANUFACTURING COMPANY, 100 Washington Street, is taxed to its full capacity in turning out the well-known Knapp annunciators.

MR. F. E. DRAKE, of the Standard Electric Company, is as usual busy looking after the interests of the company. He reports business as being in fine shape, and prospects for the future very bright.

THE CUTLER HAMMER MANUFACTURING COMPANY has been doing a brisk business during the year in its well-known fire-proof rheostats, and reports a steadily increasing demand. The company has entirely recovered from the effects of the fire which totally destroyed the factory last February, and is now carrying a larger stock than ever, being prepared to ship from stock any size automatic starting box, from ¼ to 50 hp, and larger sizes up to 200-hp. on short notice.

THE CENTRAL ELECTRIC COMPANY is receiving some very nice orders for its new insulating material, known as "micanoid," which is made up in commutator-insulating segments, and for general insulating purposes. The company is making some very large shipments of the Billings & Spencer drop-forged commutator bars and overhead material, and its changeable electric headlight is meeting with the approval of railway men in general. The company is distributing a handsome catalogue fully illustrating and describing the Billings & Spencer products.

THE GATES ELECTRIC MANUFACTURING COMPANY reports the sale of a complete electric-light plant for the United States Insane Asylum, at Phœnix, Ariz. This plant will comprise one 25-kw multipolar generator, with a handsome slate switchboard; one Ideal engine and an outfit of the Electric Storage Battery Company's chloride accumulators. The Gates Company has also sold to the United States Prison at Yuma, Ariz., a complete electric-light outfit, to be precisely the same as that for Phœnix, and has also installed a 75-hp multipolar motor in the works of Fraser & Chalmers, this city. Other work under way includes a 60-kw multipolar dynamo for the Standard Hotel, four 100-kw and one 80-kw railway generators. The company's business has increased to such an extent that it has become necessary to increase its facilities. Propositions have been received from the cities of Elkhart and Goshen, Ind., to build a brick factory, two stories high, 75 x 200 feet with out-buildings, giving them ground 150 x 300 feet, and also to put in side tracks, provided the company will move its plant to either of these towns.

Canadian Notes.

OTTAWA, Nov. 22, 1895.

EDMONTON, N. W. T.—This town is talking electric street railway.

HINTONBURG, ONT.—The Ottawa Electric Light Company have received a contract for lighting the village of Hintonburg.

WINDSOR, ONT.—Edmund Bristol is one of the syndicate asking for a charter for an electric railway between Windsor and Montreal.

JOLIETTE, QUE.—The Chamber of Commerce is discussing the project of an electric railway between Joliette and Lanoraie, to connect the St. Lawrence navigation.

QUEBEC.—The Quebec & Montmorency Electric Power Company are now considering a proposal to light public buildings in Levis, and to convey the electric current across the St. Lawrence for the purpose by means of a cable laid at the bottom of the river.

CANSO, N. S.—The Canadian Pacific Telegraph Company, in connection with the Commercial Cable Company, is engaged in running a heavy copper wire from Boston to Canso for cable business. The wire is the heaviest in use in Canada for telegraph service.

HAMILTON.—The Hamilton, Brantford & Pacific Junction Railway Company is applying for a charter to construct and operate, by steam or electricity, a line of railway from a point on the Toronto, Hamilton & Buffalo Railway to a point on the Canadian Pacific Railway, at Schau Station.

FRASERVILLE, QUE.—The Fraserville Electric Power Company is applying for incorporation, with a capital stock of $25,000, to operate telephone lines and electric lighting plants and to supply electric motors for commercial purposes in Kamouraska and other counties in the Province of Quebec.

CHAMBLY, QUE.—The Richelieu River Hydraulic & Manufacturing Company, which is applying for incorporation, proposes to construct dams, bridges, waterworks, and establishments for the manufacture of electrical machinery and apparatus. Sicotte & Bernard, of Montreal, are the solicitors for the company.

PORT PERRY, ONT.—Application to Parliament is being made by the Huron & Ontario Railway for incorporation, for the purpose of building an electric railway from Port Perry to Kincardine, touching at Newmarket, Bradford, Beeton, Shelburne, Princeville, Durham, Walkerton, Durban, Meaford, Owen Sound and Southampton.

BARRIE, ONT.—Letters-patent have been issued incorporating the Barrie & Allendale Electric Street Railway Company, with a total capital stock of $50,000. The promoters are J. H. McKeggie, J. Vair, G. Reedy, S. J. Sanford and J. Dickinson, all of Barrie, and the object of the company is to construct and operate an electric railway in Barrie, and a mile and a half beyond.

OTTAWA.—The home government has been advised that as a result of a recent conference with the British government two representatives from Canada, two from Australia and two from England are to be appointed to form a commission to draw up a final scheme for laying a Pacific cable from British Columbia to Australia. South Australia demands an indemnity on account of existing lines as a condition of its support.

A 5000-light generator has just been installed in the steam station of the Ottawa Electric Light Company. In the company's "Standard" station a generator of 250 horse-power has been put in for motor servi e. Both were made in this city.

Negotiations are in progress for an electric road between Renfrew, Ont., and Portage du Fort. The distance is eight miles, and water-power will generate the electricity. A. C. Wright, of Renfrew, is interested in the project.

MONTREAL, QUE.—A winding-up order has been issued by the Superior Court against St. Jean Baptiste Light Company, of Montreal.

A party of the directors of the United Tramways Company, of Dublin, Ireland, have been inspecting the principal electric street railway systems of Canada and the States, with a view to establishing an electric system in their city. The party is composed of William Carte, president; William Anderson, manager; William Murphy and John R. Wigham, directors.

It is said that one of the acts of the new management of the Grand Trunk Railway will be the substitution of electricity for steam in the St. Clair tunnel. The system decided on is said to be a modification of that used by the Baltimore & Ohio Railway in the great tunnel at Baltimore.

PETERBORO, ONT.—The William Hamilton Manufacturing Company and the Canadian General Electric Company have received the contract for the water power and general machinery and the electric plant, respectively, for the first three-phase electric plant erected in Canada, from the town of Trenton. These contracts involve an outlay of $50,000 and it is proposed to run electric wires to Belleville, 12 miles distant, for the transmission of electricity for light and power.

AYLMER, QUE.—Mr. Viau, owner of the franchise for the proposed line of electric railway between Hull and Aylmer, is negotiating a deal with New York capitalists for completing the road. He is now negotiating with the farmers along the proposed line for right of way, and he says the result is more satisfactory than he had expected. He secured his charter from the Quebec government in spite of a strong political influence that was at work against him, as there were a number of others who wanted the charter.

THE PARK & ISLAND RAILWAY COMPANY has secured the right of way for the new route to St. Laurent, and a large staff of men, horses and carts are pushing the work. The route over which it is proposed to build the line is not the same as first contemplated, and it is said by the company that the present route is far superior to the one formerly chosen. The line will cross the island at about its centre, striking on its way the lower part of the municipality of Cote des Neiges and passing the St. Laurent race course.

QUEBEC, ONT.—Canadian capitalists are interesting themselves in the project of an electric street railway in Buenos Ayres, Argentine Republic. The city has 750,000 inhabitants, and there are only two streets in which the electric company has not the right to lay down tracks. The matter has been brought to the attention of capitalists by J. Arthur Maguire, Consul-General here for the Argentine Republic, and several men of wealth, who, apparently, have not sufficient confidence in the future of their own country to invest their money here, are joining the promoters of the Buenos Ayres railway.

TORONTO.—The Toronto, Hamilton & Niagara Falls Electric Railway Company is applying for a charter for constructing a line of railway from the city of Toronto to the city of Hamilton, passing through the township of York to the village of Islington, in the township of Elotescoke, the villages of Dixie, Cooksville and Credit, in the township of Toronto, the villages of Trafalgar and Palermo; thence to the villages of St. Annes, Nelson, Burlington, across Burlington Beach through the township of Saltfleet and Boston to the city of Hamilton; thence to some point on the Niagara River. Also from the village of Grimsley to Dunnville.

ENGLISH NOTES.

[FROM OUR OWN CORRESPONDENT.]

LONDON, NOV. 13, 1895.

ROAD CARRIAGES.—Some time ago *The Engineer* announced that it proposed to give 1000 guineas in prizes in connection with a road carriage competition. In its issue of November 8, *The Engineer* publishes in full the conditions of its proposed competition. The judges will be Sir Frederick Branwell, Mr. John Audley Aspinall, (Chief Mechanical Engineer to the Lancashire & Yorkshire Railway,) and Dr. John Hopkinson. The vehicles are to be divided into four classes, and will receive prizes of 350, 300, 200 and 150 guineas respectively. The trials are to consist of a 100 mile run out and home, 200 miles in all. The competitors can go as they please, at any speed they think proper, running day and night or stopping as they think best, but no speed over 10 miles an hour will be placed to the credit of any competitor. The limit of weight is two tons. The competition will probably take place about this time next year.

ELECTRIC SUPPLY IN PARIS.—At a recent meeting of the *Societe Internationale des Electriciens*, M. J. Laffargue read an interesting paper dealing with the electric supply business in Paris. From this it would seem as if distribution under the 5000-volt alternate-current system is on the increase. M. Laffargue showed several load curves. The combined load curve for Paris showed a maximum output of 6778 kilowatts. This maximum may be contrasted with that of London, which according to the curve given by Mr. Compton, in his presidential address to the Institution of Electrical Engineers, in January last, was on Dec. 24, 1894, 11,600 kilowatts. During 1894 the total output of the Paris central stations amounted to 7,883,434 kilowatt-hours. According to M. Laffargue the horse-power of the isolated electric plants in Paris aggregates 25,760, including 700 gas engines of a total 2250 hp and some 500 hp of compressed air motors.

General News.

NEW INCORPORATIONS.

THE AMERICAN SIGNAL COMPANY, Chicago, Ill., has been formed by Charles S. Arnold, Joseph P. Eames and John T. Bailey to manufacture and sell electrical and other machinery and appliances. Capital stock, $100,000.

THE GOUVERNEUR ELECTRIC LIGHT & POWER COMPANY, Gouverneur, N. Y., has been incorporated, with a capital stock of $500, by Carrie McCrea, J. M. Kilmer, and J. B. McIntyre, of Governeur, N. Y., to make and use electricity for light, heat and power.

STANDARD BRASS & ELECTRIC COMPANY, St. Paul, Minn., capital stock $50,000, has been formed for the purpose of manufacturing electrical and mechanical apparatus and supplies. The promoters are Jehiel H. Jagger, Jacob Weilbron and Theodore Guitting, St. Paul, Minn.

THE HOLTON ELECTRIC COMPANY, Kansas City, Mo., has been incorporated for the purpose of building and operating electric light and power plants. Those interested are C. A. Ross, W. H. Blood, Jr., Kansas City, Mo., and L. P. Bonebrake, Maryville, Mo. Capital stock, $10,000.

THE PREMIER ELECTRICAL COMPANY, Springfield, N. J., capital stock $50,000, has been formed to manufacture, buy, sell and deal in electrical apparatus and appliances. The promoters are Louis A. Jackson, New York City, Daniel Jackson, New York City, and Leon Abbett, Hoboken, N .J.

THE ST. MARY PIPING COMPANY, Spokane, Wash., capital stock $500,000, has been incorporated to erect and operate electric light and power stations and engage in other enterprises. Those interested are H. S. Voorhees, J. L. Willson, R. H. Voorhees, J. H. Burke, T. E. Jefferson and H. L. Willson.

THE HAFEMEISTER ELECTRIC & MACHINE COMPANY, Cleveland, O., has been organized for the purpose of manufacturing machinery and electrical goods. Among those interested are F. C. Hafemeister, C. C. Spaller, Henry F. Stolte, William C. Hafemeister and E. F. Cowley. Capital stock, $5,000.

THE CONTOOCOOK ELECTRIC LIGHT COMPANY, Contoocook, N. H., capital stock $10,000, has been organized by Walter S. Davis, G. A. Curtice, Horace I. Davis, George W. Paige, and Amos A. Currier, Contoocook, N. H., for the purpose of constructing an electric light plant in Contoocook and Warner.

THE METROPOLITAN ELECTRIC & POWER COMPANY, Allegan, Mich., has been incorporated to do a general electric supply and water power business. Those interested are John S. Rannay, Chicago, Ill.; F. A. Makin, Samuel Clark, Montery, Mich, and Frank Semon, Allegan, Mich. Capital stock, $50,000.

THE NORTONVILLE ELECTRIC LIGHT, HEAT & POWER COMPANY, Nortonville, Kan., has been incorporated with a capital stock of $2290, for the purpose of manufacturing and supplying light, heat and power. The promoters are John Campbell, John W. Harris, L. F. Randolph and C. C. McCarthy, Nortonville, Kan.

THE WASHINGTON LIGHT, HEAT & POWER COMPANY, Washington, N. J., has been incorporated with a capital stock of $24,000, by John Karr, Hackettstown, N. J.; William A. Stryker, Frank P. McKinstry, John W. Fitts and Joseph W. Johnston, Washington, N. J., for the purpose of generating electricity for light, heat and power.

THE WESTERN ELECTRIC TRANSIT & POWER COMPANY, Boulder, Col., has been formed for the purpose of constructing and operating an electric railway in Boulder County. The promoters are Edwin B. Goodwin, H. J. Danford, M. K. Mehollin, Bernard Mallor, Frank Kline, Oliver J. Cheney. Boulder, Col. Capital stock, $100,000.

THE INTERNATIONAL ELECTRIC COMPANY, New York City; has been incorporated in West Virginia by John H. Haukins, Steubenville, O., C. M. Rundle, Danbury, Conn., and C. V. P. Lansing, Seattle, Wash., for the purpose of manufacturing motors, dynamos and all kinds of electrical apparatus. Capital stock, minimum $10,000, maximum $2,000,000.

THE SCOTT & JENNEY ELECTRIC & MANUFACTURING COMPANY, Philadelphia, Pa., has been incorporated in West Virginia by Dudley W. Lane, George W. Edmunds, Charles Watson and George H. Hill, Philadelphia, Pa., for the purpose of manufacturing electric motors, dynamos, etc. Capital stock, minimum $5,000, maximum $5,000,000.

THE LOS ANGELES PETROLEUM, SMELTING & MILLING COMPANY, Los Angeles, Cal, has been organized to buy and construct railways, telephone lines and electric light systems, and also to promote other enterprises. The incorporators are J. H. Canavan, E. N. Wade, E. J. Reed, J. H. Bryant, Los Angeles, Cal , and J. Keese, Pasadena, Cal. Capital stock, $200,000.

THE CHICAGO WATER HEATER COMPANY, Chicago, Ill., has been formed for the manufacture and sale of heaters, ranges, stoves and all kinds of machinery, utensils and apparatus for heating buildings, cars and other structures by water, steam, air or electricity. Those interested are B. W. Sherman, Samuel E. Hibben and John L. Jackson. Capital stock, $10,000.

THE NEWARK CONSOLIDATED ELECTRIC RAILWAY COMPANY, Newark, Ohio, has been incorporated in West Virginia, for the purpose of constructing and operating railways, the motive power to be electricity. The promoters are Reinhardt Scheidler, J. A. Flor, John Schlagal, F. A. Crane, W. C. Christian, Newark, O. Capital stock, minimum, $500; maximum, $250,000.

THE PASADENA & ALTADENA RAILWAY COMPANY, Pasadena, Cal., has been formed to construct a railway to be operated by electricity, stationary or locomotive gas or steam engines or by wire cables. The promoters are Leon P. Lowe, Thaddeus S. C. Lowe, L. A. Lowe and Herbert C. Brown, Pasadena, Cal., and Thaddeus Lowe, Altadena, Cal. Capital stock, $100,000.

ACETYLENE ELECTRO-GAS COMPANY, Philadelphia, Pa., has been incorporated in West Virginia, for the purpose of manufacturing calcium carbide and other metallic compounds and liquifying acetylene. Those interested are I. D. McKee, Joseph Cooper, William T. Emerson and Edward P. Carpenter, Philadelphia, Pa. Capital stock $1,000 minimum, and $1,000,000 maximum.

THE MEXICAN NATIONAL EXPOSITION & LAND COMPANY, Jersey City, capital stock $1,000,000, has been formed for the purpose of establishing electrical works, tramways, and engaging in other enterprises. The promotors are: John P. Stockton, Trenton, N. J.; John R. Dos Passos, New York City; J. M Ceballos, New York City; C. N. Jordan, Brooklyn, N. Y.. and H. S. Hollins, New York City.

ELECTRIC LIGHT AND POWER.

SISTERSVILLE, W. VA.—Sistersville is to have an electric light plant with a capacity of 50 arc lamps and 2000 incandescents.

MEDINA, N. Y.—The village authorities will receive bids up to Dec. 2, for street lighting. The village clerk can give particulars.

NEW ALBANY, IND.—Mayor T. W. Armstrong has recommended to the Council the letting of a contract for gas or electric lighting.

NEW ORLEANS, LA.—George T. Whitney and A. S. Badger have been appointed receivers for the Louisiana Electric Light Company.

WEST HAZELTON, PA.—The West End Electric Light & Power Company will make arrangements immediately for the erection of its plant.

PARSONS, PA.—The Council will sell $700 worth of bonds to pay for the site for an electric light plant which will probably be erected in the near future.

TREMPEALEAU, WIS.—The Bluff City Telephone Company proposes to build a telephone line from Trempealeau to Centerville, a distance of five miles.

ST. PAUL, MINN.—The question of lighting the city is daily becoming more complicated and the authorities seem to be at a loss as to just what course to pursue.

WOLCOTT, N. Y.—At the last meeting of the Wolcott Village Board, Omar M. Curtis made formal application for a franchise for operating an electric light plant.

CHESTER, PA.—At an adjourned meeting of Council it was decided to put a 100-hp engine in the electric light station, instead one of 80-hp, at a cost not to exceed $100.

SCHENECTADY, N. Y.—The Schenectady Illuminating Company has certified its determination to extend its business to the towns of Rotterdam, Glenville and Niskayuna.

WEST SCRANTON, PA.—The Manufacturers' Committee of the West Side Board of Trade has under consideration the establishment of an electric light plant on the west side.

NEWBURGH, N. Y.—Arrangements will probably be made for the lighting of the club house at Pine Point, Orange Lake, with electricity. H. C. Higginson is constructing the building.

MISSOULA, MONT.—Missoula is to have a new electric light. H. M. Byllesby has been in the city several days, looking over the ground and making arrangements to put in a new plant.

ABILENE, KAN.—The city electric light plant has been shut down, after being in operation for ten years, owing to decreased rental. A number of Kansas City capitalists propose to put in a new plant.

INDEPENDENCE, MO.—A movement is on foot to induce the Metropolitan Street Railway Company, of Kansas City, to furnish the city with electric lights from the power house on the Blue near Sheffield.

SHREVEPORT, LA.—Sealed proposals will be received until Dec. 12 for lighting the city for a term of five or ten years, beginning May 1, 1896, with 50 to 80 arc lights of 2000 cp, to be lighted every night from sunset to sunrise.

SING SING, N. Y.—Warden O. V. Sage, of Sing Sing Prison, has decided to replace the kerosene lamps in the cells with electric lights. Since he has been in charge of the prison several prisoners have set fire to the beds in their cells.

CHICAGO, ILL.—The business men in North Clark Street are protesting against the condition of the streets, and have decided to have 250 arc lights, in addition to the street lamps already in use, distributed between the river and Chestnut Street.

TRENTON, N. J.—A special meeting of the lamp committee of the Common Council will be held for the purpose of considering the advisability of providing the city with its own lighting plant. Councilman Jackson, chairman of the lamp committee, can furnish further particulars.

NIAGARA FALLS, N. Y.—Secretary Rankine, of the Falls Power Company, says that proposals have been invited for the enlargement of the wheel-pit to accommodate three more turbines to drive three new dynamos of 5000 horsepower each. The work is to be completed within six months.

SARATOGA, N. Y.—The property of the Saratoga Gas & Electric Light Company was sold on Monday, Nov. 18, on a judgment obtained in favor of the New York Security & Trust Company. The property was bid in by Lafayette B. Gleason, representing a committee of the bondholders, for $100,000. The judgment amounted to $300,000.

CINCINNATI, O.—Sealed proposals will be received at the office of the Board of Administration, until 12 m. Dec. 3, for furnishing one complete duplicate electric light plant, embracing dynamos, engines, lamps, wiring, switches and belting, set in place, ready for service, at the Hunt Street pumping station. August Herrmann is president of the board.

LOWELL, MICH.—At a special meeting of the Common Council, Trustee J. E. Lee, who was previously appointed a committee, with power to act in securing options to a water power at Flat River, for an electric plant, made a report, and a committee was appointed to make estimates of the cost of the erection and equipping of a municipal plant.

MONTCLAIR, N. J.—The electric light ordinance was discussed at length at a recent meeting of the Montclair Town Council. Councilman Sanford stated that an offer had been made by a company to supply East Orange with an underground system, and President Snow of the Electric Light Company stated that his company would not consider a proposition to place the wires underground.

HAGERSTOWN, MD.—Mr. Powell Evans, representing a party of Philadelphia capitalists, has purchased the electric light plant in Hagerstown. The Street Commissioners consented to the sale only when Mr. Evans agreed to furnish street lighting to the town at the rate of $75 a year for each light. The Schuyler Company's contract was for $80 a year. The new contract is for a period of five years, with a conditional contract for an additional five years at the same price per lamp, providing Mr. Evans succeeds in furnishing electric power to Hagerstown factories, which is a part of his project.

The Electric Railway.

POTSDAM, N. Y.—Surveyors for the proposed trolley line between Potsdam and Westchester, began work on Nov. 11.

PLATTSBURG, N. Y.—Civil Engineer W. H. Stair has commenced a preliminary survey for a proposed electric railway.

WOONSOCKET, R. I.—It is reported that the Street Railway Company will extend its trolley system to the Fair Grounds.

SKOWHEGAN, ME.—A preliminary survey of the proposed electric road between this place and Madison has been completed.

UNIONVILLE, PA.—The citizens of Unionville are making efforts to secure an electric railway from Unionville to West Chester.

BEVERLY, MASS.—It is reported that the Beverly & Danvers Railway is to be converted into an electric line using a trolley system.

FLUSHING, L. I., N. Y.—Engineers of the Brooklyn City Railway are in Flushing surveying the proposed route of the entrance into this village.

RICHMOND, VA.—The Richmond Traction Company has negotiated a mortgage of $500,000 in Baltimore, Md., to complete its rapid transit system.

NIAGARA FALLS, N. Y.—The Niagara Falls Street Railway Company has sent a second petition to the Council for a franchise to build a line on Niagara Street.

DOWNESVILLE, N. Y.—The route of the proposed electric railway between Syracuse and East Branch has been laid out by engineer W. F. Randall, of Syracuse.

HYATTSVILLE, MD.—It is stated that an electric railway will be constructed to run through this place parallel with the tracks of the Baltimore & Ohio road.

REYNOLDSVILLE, PA.—A movement has been started at Reynoldsville to put in an electric light plant and build an electric railway to Rathine, three miles distant.

EAST BERLIN, CONN.—It is probable that the Middletown Electric Railway Company will extend its lines to connect with those of the Central Railway & Electric Company.

SHELBY, MICH.—The contract for the electric light plant has been awarded to the Furniture City Electric Company, of Grand Rapids, Mich., and is to be in operation on Jan 1, 1896

BURLINGTON, VT.—The Board of Aldermen has granted to the Winooski & Burlington Street Railway Company the right to run a line through the northwestern part of the city.

MEADVILLE, PA.—Both branches of the City Council have taken action which tends to the speedy and proper settlement of the street railway question and the granting of a franchise.

WEST ORANGE, N J.—The township at a recent meeting finally passed the much-discussed franchise giving the South Orange & Maplewood Street Railway Company a right of way.

BANGOR, ME.—The Bangor, Orono & Oldtown Railway Company has filed application for permission to construct and operate a street railway in State Street, from Broadway to Exchange Street.

MONTCLAIR, N. J.—An ordinance, granting a franchise to the North Jersey Street Railway Company for a trolley road on Bloomfield Avenue, has been vetoed by Mayor Harrison of Caldwell Borough.

WEST HOBOKEN, N. J.—A meeting was held in Union Hill recently, in order to get the opinion of the property owners in reference to the feasibility of pushing the plans for a trolley line along Main Street.

LANCASTER, PA.—An electric road will be built from Philadelphia to Lancaster via Cochranville, with a branch to Oxford, and $14,000 has been subscribed by residents in the neighborhood of Cochranville.

PHILADELPHIA, PA.—An ordinance has been passed giving the Grand Boulevard Street Railway Company the right to erect poles and wires and to construct conduits between its tracks through certain streets.

SPRINGFIELD, MASS.—The Board of Aldermen have granted the Street Railway Company the right to lay a double track from the Ingleside turnout to the city line on the West Springfield Road, a distance of about 3000 feet.

PITTSBURG, PA.—The Select Council has passed an ordinance granting the Federal Street & Pleasant Valley Passenger Railway Company the right of way through Charles Street, from Erwin Avenue to Perryville Avenue.

RICHMOND, IND.—John J. McIntire, of Dayton, Ohio, and some of the stockholders of the Barnet-Smith Car Works have organized a company for the purpose of building an electric railway between Richmond and Dayton.

NEW HAVEN, CONN.—It is stated that the Winchester Avenue Railway Company will take an appeal from the recent action of a lower court, requiring the company to pay the city $700 a year per mile of track through Washington Street.

MILLBURY, MASS.—Indications point to another street railway, to be known as the Millbury, Sutton & Douglas Electric Railway. James W. Stockwell and Thomas E. Meek, agent of the Douglas Axle Company, are at the head of the enterprise.

BROOKLINE, MASS.—A street railway is contemplated to run from Newton Centre to this place, and to be ultimately extended through Newberry Street, Boston. William H. Lincoln, Boston; W. A. Bowland, New York City; Alfred B. Chandler, Brookline, and others are interested

ALBANY, N. Y.—The Albany, Helderberg & Schoharie Railway Company proposes to build a railroad from Albany to Schoharie, a distance of 30 miles, to be operated by electricity, steam or compressed air. Jonas H. Brooks, B. M Secor, John W. Van Valkenburgh, Robert J. McCauley, of Albany, and others, are interested.

BRADFORD, PA.—Stock has been subscribed and the details of organization perfected for a company which proposes to build an electric railway from the corner of Main and Congress Streets, through Congress, Mechanic and other streets, and application for a franchise will be made at the next meeting of the Council.

ECORSE, MICH.—The township board has granted the Ecorse Electric Railway Company a franchise to construct and operate for a term of thirty years an electric street railway through this village. Charles W. O'Brien, of 77 Moffat Building, Detroit, and Hyacinthe C. Burke, of River Rouge postoffice, are the promoters of the enterprise.

VALPARAISO, IND.—A scheme is under way looking to the construction of an electric railway from Valparaiso to Lake Michigan. Those interested are W. W. Kimball, president of the Hydraulic Pressed Brick Company; Deloss

D. Phelps, and W. W. Shope, of Chicago; H. B. Darling, of Boston; and Messrs. Harris & Evans, of Worcester, Mass.

AKRON, O.—The old Akron & Cleveland Electric Railway Company, which two years ago secured franchises from Akron to Cleveland, via Richfield, has joined hands with the Akron & Cuyahoga Falls Rapid Transit Company and work on the line will be commenced at once. C. F. Dunbar, F. M. Chandler, and F. M. Wilcox, of Cleveland, are interested.

OSWEGO, N. Y.—The directors of the Oswego Street Railway Company held a meeting in New York City recently, and perfected plans by which the line will be electrically equipped and considerable extensions made. Some changes in the management have taken place, and the name of the road will be changed to the Riverside Electric Railway. Lawrence Clancy, George N. Burt, George D. Hart and Charles H. Tanner are interested.

MISCELLANEOUS.

THE ELECTRIC CLUB, OF CLEVELAND, O., will hold its regular meeting at the club rooms, 356 Superior Street, on Wednesday evening, Dec. 4, at 8 o'clock. Prof. C. H. Benjamin, of the Case School of Applied Science, will address the members on the subject, "Fly Wheels, and Why They Burst."

Trade and Industrial Notes.

THE WESTINGHOUSE GLASS FACTORY, at Pittsburg, Pa., is turning out some pretty and novel designs in incandescent lamp shades. Mr. J. H. Reid is Western representative, with headquarters at 1141 Monadnock Building, Chicago.

A UNIQUE CIRCULAR is being distributed by the Chicago office of the Michigan Bolt & Nut Works, of Detroit, announcing the fact that Mr. T. S. Bigler has been placed in charge of that office—which arrangement cannot fail to result in the addition of more lustre to the already high favor with which this long-established company is regarded.

THE CARPENTER ENAMEL RHEOSTAT COMPANY, Hoboken, N. J., on account of the increase in its business, has made a large reduction in prices to certain classes of its customers. The company's wise policy of reducing prices whenever possible has had a telling effect upon its business, purchasers of rheostats having demonstrated their appreciation of the square dealings in the many ways possible between buyers and sellers.

AN IMPORTANT ATTACHMENT for boilers is being introduced by the Hascall, Richard Steam Generator Company, of 36 Bromfield Street, Boston. The arrangement consists of a frame-work of pipes, located immediately below the shell of the boiler, the value of which as a means of relieving a crowded boiler is obvious. The attachment can be applied to any boiler without trouble and besides giving additional heating surface it serves to materially lessen the time required in getting up steam.

THE DIAMOND STATE COMPANY is the title name of the firm recently established at Wilmington, Del., for the purpose of manufacturing hard fibre for electrical insulation and various mechanical purposes. The factory is equipped with the most modern machinery and electrically lighted by the company's own plant. It is reported that the new company has already received some very flattering orders from good firms, which augurs well for future prospects. The factory and offices are at Ellsmere, Wilmington, Del.

THE SOUTHERN ELECTRICAL CONSTRUCTION & SUPPLY COMPANY is the name of a new concern which was recently organized in Norfolk, Va., for the purpose of doing general construction work and handling high-grade electrical supplies. Mr. Paul K. Browd, the manager of the new company, is an engineer of considerable experience and fine ability, and Mr. Beardsley N. Sperry, the treasurer, is also an electrical engineer and a man of excellent business qualifications. Both men were recently identified with the Solvay Process Company, of Syracuse, N. Y., where they had a varied practical experience in many branches of electrical construction work.

A FINE SPECIMEN of typographical work is the latest catalogue of the Ball Engine Company, of Erie, Pa. The numerous styles of Ball engines are illustrated and described in detail, and particular care has been taken to properly present the merits of the telescopic balanced slide valve and the governor mechanism, both of which have so largely contributed to the wholesale success and enviable record enjoyed by the Ball engine throughout the entire United States. The large amount of information presented concerning the care and operation of these engines makes the catalogue as valuable to central station men already owning Ball engines as to those contemplating an increase in their steam plant.

THE ITHACA DESK COMPANY, of Ithaca, N. Y., has issued its first catalogue of office furniture. The catalogue is an illustrated one, and describes a large variety of handsome desks, prominent among which is the roll-top style. A new form of roll-top desk is shown, which has two roll-curtains, one enclosing the desk proper, and the other serving to protect a document filing case, which forms the upper part of the structure, just over the pigeon-hole portion of the desk. This construction is obviously one of great convenience. Another exceedingly convenient desk combination is a roll-top typewriter desk, the typewriter shelf of which is located at the top of the tier of drawers on the right of the desk, relieving the desk table entirely from any disturbance when the use of the typewriter is desirable.

THE ELECTRICAL TRADES ASSOCIATION has just been formed in Philadelphia, and incorporation papers have been applied for. The object of the association is the mutual advancement of the interests of the manufacturers and wholesale dealers of electrical goods. An initiation fee of $10 will be charged, and the yearly dues will be $25. Several representative houses outside of Philadelphia have manifested a desire to become members. The officers of the association are as follows: President, C. E. Trump, of the Novelty Electric Company; vice-president, C. M. Wilkins, of the Partrick & Carter Company; treasurer, P. Logan Bockius, of Frank H. Stewart & Co.; secretary, Richard Cadbury. Among the incorporators are Alfred F. Moore, A. Bournonville, M. R. Muckle, Geo. Vallee and Frank H. Stewart. The association has offices at 735 Drexel Building.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, reports that its monthly publication, known as the *Electrical Trade*, is being well received by the electrical people generally. Each issue contains several pages of very interesting reading matter, and the general make-up of the publication is highly creditable to the enterprising originators. The Appliance Company is getting good reports also from Packard lamps, of which the following letter from the Monroe Electric Light & Power Company, Monroe, Mich., is typical: "We have one Packard 16-cp 104-volt lamp still burning every night on an average of over 12 hours a night ever since Nov. 14, 1891. This is the only one left of the first lot that we bought of you. It has now burned over 17,500 hours, and it still burns brightly, and the globe is only blackened up a very little. Can anybody on your books beat that for a long burning lamp? There is no telling how long it will still burn."

THE MAMMOTH CATALOGUE promised some time ago by the Metropolitan Electric Company, of Chicago, has made its appearance, and it is a veritable giant. It would be very difficult to mention anything used in connection with electrical work that is not included in the tastefully arranged pages of the book, which is, on this account, exceedingly useful and convenient as a general reference book for contractors and supply dealers, irrespective of the numerous other admirable features. Probably the most comprehensive telegraph code ever contained in a catalogue of this character is the one provided in this book. Another valuable feature consists in the incorporation in its pages of the rules of the Chicago Fire Department and an unusually large number of wiring tables, applying to low-potential incandescent work, alternating-current primary circuits, and power mains for stationary motors. Between 15 and 20 diagrams of circuits are also given, which will be found of much value by those who have not had sufficient experience to be able to make their own plans. Taken altogether, the catalogue is one of the best productions of its class that has ever been issued in any line of business and reflects great credit upon the able hands which guided the stupendous work of preparation.

A MAGNIFICENT CATALOGUE has been issued by the Fort Wayne Electric Corporation, of Fort Wayne, Ind., in which is described and illustrated the complete line of apparatus now manufactured by the company, which is by no means small. The illustrations are particularly well executed, and the descriptive matter, though brief, is clear and to the point. The high reputation which has been established for the work of the company's electrician and general superintendent, Mr. J. J. Wood, renders unnecessary any specification of the many points of excellence embodied in this apparatus, and therefore the reading matter accompanying each illustration is restricted to a concise description of the piece of apparatus illustrated. Six most interesting pages are those devoted to the latest Wood arc light machine (125 lamps capacity) and its automatic regulator. So many of these machines have been sold and they have become so well known during the short time they have been on the market that the type cannot consistently be termed "new" any longer. The catalogue is conveniently divided into three parts devoted respectively to arc lighting apparatus, alternating-current apparatus and direct-current constant-potential apparatus. Each section of the book is very comprehensive, including descriptions and illustrations of every detail of the apparatus coming under its head. The general appearance and typographical work are superb in every respect, and it is evident that the ability and care bestowed upon the presentation of the company's product to the trade on paper is typical of the fine business policy which has achieved such signal success in introducing the product itself.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 19, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

549,899. PLATE FOR STORAGE BATTERIES AND PROCESS OF MAKING IT; F. J. Clamer, Philadelphia, Pa. App. filed Dec. 20, 1893. A plate for storage batteries consisting of a central core of oxide of lead enveloped in a porous metallic jacket of lead and aluminum.

549,906. AUTOMATIC ELECTRIC FIRE ALARM; H. A. Edgecomb, Mechanic Falls, Me. App. filed Jan. 5, 1894. The combination of a non-conducting base having a fusible plug inserted therein, plates attached normally out of contact with each other, a spring attached to one of the plates having its free end held out of engagement with the other plate by the said fusible plug, and a push button mounted in a cover and adapted to cause a contact between the said plates.

549,907. APPARATUS FOR EXTRACTING GOLD; A. L. Eltonhead, Philadelphia, Pa. App. filed Jan. 15, 1894. The combination of a mercury receiving box having a vessel therein having its lower end open, an anode strip suspended within the vessel, and a copper disc in said box, and means for reciprocating said vessel transversely.

549,916. EXPRESSION INDICATOR FOR SELF-PLAYING INSTRUMENTS. F. W. Hedgeland, Chicago, Ill. App. filed Feb. 23, 1894. The

combination for operating the expression-giving devices of an instrument of an indicator for directing a pedalist in operating the pedals, electric devices for actuating the indicator and self-playing mechanism controlling the said electric devices.

549,919. ELECTRICAL INDICATOR; J. W. Howell, Newark, N. J. App. filed Jan. 2, 1892. The combination of two coils adapted to be connected in circuit, an indicating hand mounted on a spindle passing centrally between the coils, a coil or armature on the spindle, and a bent magnetic plate on the outer face of each of the coils for modifying the magnetic fields.

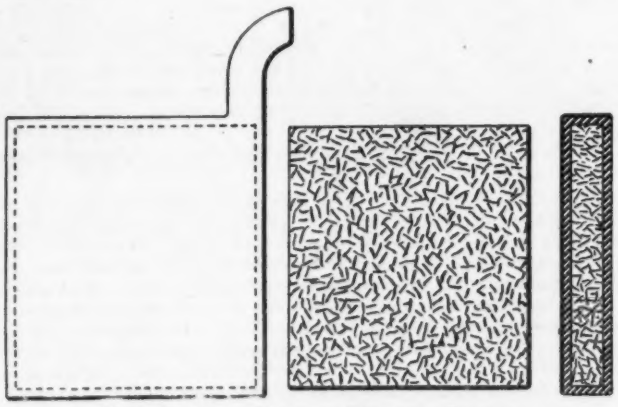
549,920. UNDERGROUND TROLLEY SYSTEM; C. E. Hubbs, Streator, Ill. App. filed May 23, 1895. A conduit consisting of a cement bed supported by the ties with a centrally depressed drain basin connecting with a drain pipe, sets of opposite castings cut away at the inner ends above the basin and terminating contiguous to each other to form a slot, track rails seated upon the cement bed near its lateral edges and connecting the outer extremities in series, castings resting between the vertical planes of the track rails, and a conductor supported by the castings.

549,995. UNDERGROUND CONDUIT; J. F. Cummings, Detroit, Mich. App. filed March 4, 1895. The combination of an outer casing and a series of inner ducts divided into sections, and valves to control the end of each duct, and conductors in the ducts passing through the valves.

550,008. SELF PROPELLING VEHICLE, BOAT, ETC.; G. A. Washburn, Cleveland, O. App. filed March 6, 1895. The combination of a driving axle, a prime mover, a dynamo-motor, means for throwing the prime mover and dynamo-motor into and out of engagement with the driving axle, an electric accumulator and suitable switching and controlling devices in circuit therewith whereby the dynamo-motor may be actuated to operate the prime mover.

550,018. ELECTRICAL STEERING GEAR; F. L. & L. H. Dyer, Washington, D. C. App. filed Oct. 4, 1894. The combination of a steering engine controlled by a valve, an electric motor tending to constantly open the valve, and differential connections between the engine and the valve which tend to constantly close the valve when the engine is operating.

550,039. GALVANIC BATTERY; E. S. Boynton, Brooklyn, N. Y. App. filed Feb. 21, 1895. The combination of a casing closed at its sides and ends, and having a series of tubular open-ended carbon electrodes arranged end to end within and insulated at their abutting ends, whereby a continuous chamber for a liquid electrolyte is formed, the chamber extending through all of the carbons.



No. 549,899.—STORAGE BATTERY PLATE.

550,042. ELECTRIC FAN; P. Diehl, Elizabeth, N. J. App. filed May 11, 1891. An electric fan consisting of a wheel having a central hub provided with a ring of insulating material, metallic blades attached to the ring and a ring armature to which the outer ends of the blades are attached.

550,044. RHEOSTAT FOR USE IN ELECTRIC MOTOR CIRCUITS; R. Eickemeyer, Yonkers, N. Y. App. filed Jan. 14, 1893. A rheostat consisting of two connected sets of contact blocks, two separate brushes, one in advance of the other, and each in cutting out resistance sweeping over its appropriate portion of said blocks independently of the other.

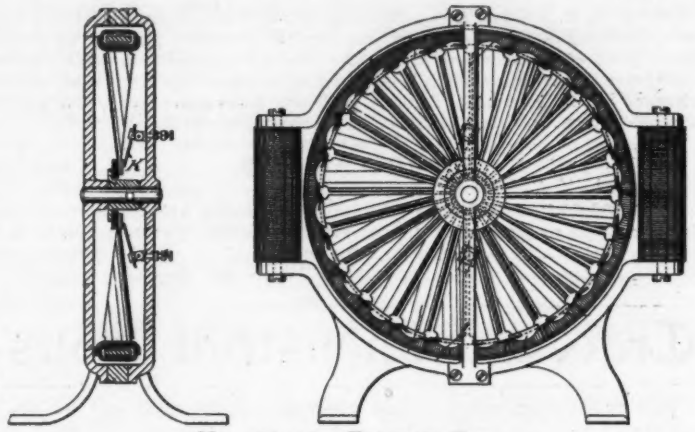
550,057. Filed Oct. 20, 1894. 550,132. Filed March 19, 1894. ELECTRIC RAILWAY; H. A. F. Petersen, Milwaukee, Wis. The combination consisting of two sections provided at their lower edges with flanges securing a partition between them, a slot rail provided with other flanges, a closing strip adapted to rest upon one of each set of flanges, and a cover plate arranged to rest upon the other flanges.

550,059. TROLLEY; F. J. Pribyl, Hazelton, Pa. App. filed March 9, 1895. A trolley rod carrying a wheel having rollers journaled thereon, adapted to receive the wire and carry it inwardly to align with the trolley wheel, and means whereby the revolution of the rollers elevates the same to the height of the trolley wheel, and a segmental strip extending normally above the same to direct the wire thereto.

550,070. GAME APPARATUS; A. W. Fall, Hoboken, N. J. App. filed March 18, 1895. A receptacle for holding water; a floating body; a number of places on the receptacle in the form of scalloped edges to which the body can be drawn, magnets located on a support under the receptacle, a toothed wheel ached to the magnets, and a pawl engaging at times with the toothed wheel, whereby the magnets are caused to assume different positions under the receptacle.

550,096. FUSE BOX OR CUT-OUT; A. C. Carey, Lake Pleasant, Mass. App. filed April 13, 1895. The combination of a binding post having a longitudinal slot and nut, a block fitting to the slot in such post and held therein by the nut, the block being divided and bored longitudinally and adapted to receive the bared end of a wire.

550,097. INSULATED PIPE COUPLING; E. E. Clift, Philadelphia, Pa. App. filed Sept. 20, 1894. The combination of a casing with an internal shoulder, a pipe within having an external flange, a cap with a threaded portion adapted to mesh with the casing with insulating material between them, a bottom-piece threaded meshing with the threaded end of the pipe, and provided with a flange which is insulated from the other parts.



No. 550,042.—ELECTRIC FAN.

550,102. UNDERGROUND TROLLEY SYSTEM; C. J. Hamilton, Philadelphia, Pa. App. filed April 26, 1895. The combination for a hinged cover suitably supported, a lever pivoted to the under side of the cover, an end of the lever being straight and adapted to project under the end of an adjacent cover, the covers having weights attached thereto.

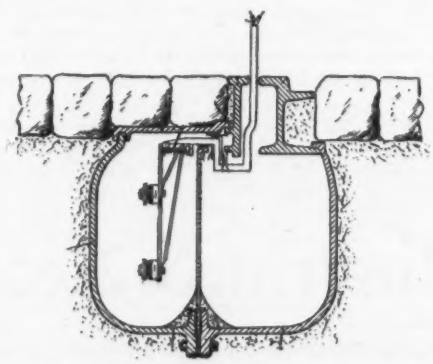
550,167. ELECTRIC BATTERY; T. Froggatt, London, Eng. App. filed May 1, 1895. A battery having an inner diaphragm having passageways for permitting the escape of gas, an outer diaphragm and a U-shaped tube having its ends communicating through the outer diaphragm, and its intermediate portion provided with perforations.

550,205. ELECTRIC TIME SIGNALING APPARATUS; J. T. A. Todd, Fort Worth, Texas. App. filed Feb. 11, 1895. The combination of an electric signaling circuit, an adjustable trailer held in a recessed hour hand by a nut having a milled outer rim and held in a slot in the hour hand, whereby the trailer can be made longer and shorter without being turned in said recessed hour hand.

550,210. RAILWAY SIGNALING APPARATUS; B. Wyckoff, Asbury Park, N. J. App. filed March 13, 1895. The combination of a movable device, a weight, a reciprocatory weight holder connected with the movable device and having a discharge, a stationary weight holder, valves and gates controlling the discharges of the movable and stationary weight holder, and a rotary conveyer adapted to receive the weight in portions when it is discharged from the movable weight holder and transfer it in portions to the stationary holder.

550,215. ELECTRIC ARC LAMP; E. Cannevel, Paris, France. App. filed April 20, 1893. The combination of a rocking frame carrying clockwork mechanism controlling the motion of a pitch wheel over which passes a pitch chain connected to the upper and lower carbon holders, an escapement with a brake disc controlling the motion of the clockwork and a brake frame acted upon by a spring controlling the motion of the escapement, and electromagnets on a shunt of the lamp circuit and carried by a frame, and controlling the motion of this frame.

550,220. ELECTRIC CAR OR LOCOMOTIVE; R. Eickemeyer, Yonkers, N. Y. App. filed April 8, 1891. The combination of an electric motor, having a casing which constitutes central, lateral and longitudinal portions of a motor frame, and four frame extensions, each detachably coupled to the motor casing and embodying an axle box jaw, the whole framework being adapted to be spring mounted.



No. 550,057.—CLOSED CONDUIT ELECTRIC RAILWAY.

550,229. CYCLE ALARM; R. McL. & A. McDonald, Dalmuir, Scotland. App. filed April 6, 1895. The combination of a cycle carrying an alarm consisting of an electric battery fitted thereto, a shocking coil connecting with the battery and having its secondary wires connected with the cycle handles and circuit closers carried by the cycle for closing the circuit through the primary wires.